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Abstracts 1287–2813

January 31, 1962

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Volume 16, Number 2 January 31, 1962

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GENERAL AND MISCELLANEOUS

Refer also to abstract 2761

1287 (ABCC-57-58) ATOMIC BOMB CASUALTY COMMISSION ANNUAL REPORT [ON RADIOBIOLOGY], JULY 1, 1957—JUNE 30, 1958. (Atomic Bomb Casualty Commission, Hiroshima). 83p. Contract AT-49-1-GEN-72.

A bilingual summary is presented of the program of research carried out by the Atomic Bomb Casualty Commission in determining the acute and delayed effects of radiation on man. No results of scientific investigations are included. (B.O.G.)

1288 (AERE-BIB-127(Suppl.1)) LIST OF UNCLASSIFIED REPORTS AND PAPERS PUBLISHED BY STAFF OF THE ISOTOPE RESEARCH DIVISION FROM SEPTEMBER 1959 TO AUGUST 1961. R. J. Millett and R. Sweeney, comps. (United Kingdom Atomic Energy Authority. Research Group. Isotope Research Div., Wantage, Berks, England). Sept. 1961. 24p.

All unclassified reports and papers published by the Isotope Research Division between September 1959 and August 1961 are listed. The 164 items are given alphabetically by first author and chronologically within that system. Subject and author indexes are included. (M.C.G.)

1289 (MLM-1114) MOUND LABORATORY MONTHLY PROGRESS REPORT [ON PLASTICS, RADIOELEMENTS, AND REACTORS] FOR APRIL, 1961. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). Apr. 30, 1961. Contract AT(33-1)-Gen-53. 14p.

Development work has been directed toward methods for producing adhesives and plastics having characteristics superior to those currently in use, methods for separating and purifying radioelements, evaluation of potential sources of supply of radioelements, and developing reactor materials and techniques leading to higher performance and/or lower costs for full scale power reactors. (B.O.G.)

1290 (TID-3568) CRITICAL PATH SCHEDULING. A preliminary Literature Search. Hugh E. Voress, comp. (Division of Technical Information Extension, AEC), Elmer A. Houser, Jr. and Fred E. Marsh, Jr., comps. (Oak Ridge Operations Office, AEC). Oct. 1961. 28p.

A bibliography of 255 published references on an activity planning technique generally known as Critical Path Scheduling is presented. (J.R.D.)

1291 (TID-13901) LONG TERM UTILIZATION OF URANIUM AND THORIUM. Donald W. Kuhn and Ray D. Walton, Jr. (Division of Operations Analysis and Forecasting. Technical Policy Branch, AEC). Oct. 1961. 36p.

A study was made to determine how utilization of uranium and thorium is affected by recycle, by the conversion ratio of the reactor, and by losses outside the reactor. Work which was done or is planned which will lead to higher utilization of fuel and reduced costs of nuclear power is reviewed. The mathematical method for estimating the utilization of energy in nuclear fuel resources is discussed and applied to a reactor fueled with uranium and producing plutonium. Programs directed toward development of breeder reactors and of plutonium's use as a fuel are discussed. The plutonium recycle program is described. (M.C.G.)

1292 (WADC-TR-53-373(Suppl.7)) A REVIEW OF THE AIR FORCE MATERIALS RESEARCH AND DEVELOPMENT PROGRAM. Donna J. Tate (Aeronautical Systems Div. Materials Central, Wright Patterson AFB, Ohio). Feb. 1961. 186p.

The bibliography covers basic and applied research in the materials area being conducted by the Metals and Ceramics, Non-Metallic Materials, Physics, and Applications Laboratories of the Materials Central. Author and contractor indexes are included. (B.O.G.)

1293 (WT-1151) TECHNICAL PHOTOGRAPHY. (Edgerton, Germeshausen and Grier, Inc., Boston). Aug. 12, 1957. Decl. Aug. 2, 1961. Project 9.1 of Operation TEAPOT. 15p. Supersedes ITR-1151.

Activities related to scientific photographic participation in the Teapot series are described. Information obtained is mainly on shots 7, 10, and 12 with lesser amounts on other shots. The summary is concerned with the overall accomplishments and does not include detailed film analyses. (J.R.D.)

1294 (AEC-tr-4141(p.1-32)) BASIC PROBLEMS OF NUCLEAR POWER. W. Frankowski. Translated from Nukleonika, 2: No. 2, 225-65(1957).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3306.

1295 PATENT LAW AND PROCEDURES: A REVIEW OF EURATOM AND NATIONAL PRACTICE. Nuclear Eng., 6: 466-8(Nov. 1961).

Patent laws and procedures necessary for the speedy establishment of nuclear energy industries are reviewed as they apply to the Euratom countries. The laws of the United States, United Kingdom, and Euratom are compared along with national practice of the individual nations. The practices of other European countries are also discussed. (N.W.R.)

1296 SOLAR ENERGY APPLICATIONS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). July 1960. 5p. (SB-418). $0.10(OTS).

The bibliography of 68 references on solar energy applications is divided according to solar power sources, solar heating, and solar distillation. (B.O.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

1297 (AD-256030) THERMAL INJURY OF THE SKIN. Report [for period] May 1, 1960-May 1, 1961. Sol Roy Rosenthal (Illinois. Univ., Chicago. Coll. of Medicine). 56p.

A hemolysin test is developed for differentiating between normal sera and the sera of burned individuals. A precipitin ring test procedure is developed; its results on convalescent burn sera and plasma, and on acute human burn sera, are discussed. The effects of thermal injury on germ-free and normal rats and mice are compared serologically. It is suggested that the blood or plasma of recently healed burned or injured donors may be beneficial if transfused into injured, burned, post-traumatic, or post-surgical patients. (T.F.H.)

1298 (LAMS-2627) BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION—SEMIANNUAL REPORT JANUARY THROUGH JUNE 1961. (Los Alamos Scientific Lab., N. Mex.). July 1961. Contract W-7405-eng-36. 309p.

Thirty-nine papers are presented on various projects administered by the Biological and Medical Research Group. The papers are divided into the following sections: molecular radiobiology, cellular radiobiology, mammalian radiobiology, mammalian metabolism, low-level counting, clinical investigations, and veterinary services. Separate abstracts have been prepared for all the papers. (D.L.C.)

1299 (LAMS-2627(p.15-32)) KINETICS OF THE DEGRADATION OF POLYMERS BY SUCCESSIVE ENZYMATIC HYDROLYSIS TO MONOMER UNITS. E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

The kinetics of a series of first-order reactions with equal rate constants are analyzed with reference to the enzymatic hydrolysis of DNA polymers as a method establishing the sequence of bases in the polymers. Curve families for the concentrations of residues and nucleotides as functions of time are presented and discussed in detail. A possible separation method is proposed. (D.L.C.)

1300 (LAMS-2627(p.33-7)) NUCLEIC ACID CHROMATOGRAPHY. A. Murray, V. E. Mitchell, and D. F. Petersen (Los Alamos Scientific Lab., N. Mex.).

Twenty-eight amine-substituted cellulose preparations were evaluated with regard to their amine base strength and absorptive properties for DNA. (D.L.C.)

1301 (LAMS-2627(p.38-44)) METHODS FOR ROUTINE PHOSPHORUS ANALYSIS OF EFFLUENTS FROM CHROMATOGRAPHIC COLUMNS. D. F. Petersen, V. E. Mitchell, and A. Murray (Los Alamos Scientific Lab., N. Mex.).

The Berenblum and Chain method of phosphorus determination was modified in its digestion technique and color development to permit precise routine analyses in the presence of high concentrations of interfering salts. (D.L.C.)

1302 (LAMS-2627(p.45-50)) DETERMINATION OF BETA ACTIVITY IN NUCLEIC ACIDS. L. B. Cole and D. F. Petersen (Los Alamos Scientific Lab., N. Mex.).

The counting procedure used to determine the distribution of tritium-labeled desoxynucleoside residues in nucleic acids was modified to eliminate pH sensitivity. The modification consists of adjusting the acid extracts to pH 8.0 to 8.5 with 1.0M tris(hydroxymethyl)aminomethane before counting. (D.L.C.)

1303 (LAMS-2627(p.51-6)) PREPARATION AND PURIFICATION OF TRITIUM-LABELED THYMIDINE, DEOXYCYTIDINE, AND ADENOSINE. A. Murray and D. F. Petersen (Los Alamos Scientific Lab., N. Mex.).

Column chromatographic techniques are presented for isolating and purifying tritium-labeled thymidine, deoxycytidine, and adenosine. (D.L.C.)

1304 (LAMS-2627(p.57-65)) ON THE SIGNIFICANCE OF RADIOLYTIC DEGRADATION OF PURINE AND PYRIMIDINE NUCLEOSIDES. D. F. Petersen, A. Murray, F. N. Hayes, and M. Magee (Los Alamos Scientific Lab., N. Mex.).

Chromatography of fresh and aged tritium-labeled thymidine, deoxycytidine, and adenosine indicates that degradation of these compounds occurs chiefly through N-glycoside cleavage and that free radical attack on the base does not produce detectable amounts of a substituted pyrimidine. (D.L.C.)

1305 (LAMS-2627(p.66-71)) NEUTRON DOSE ESTIMATES IN THE SL-1 ACCIDENT UTILIZING BIOLOGICAL SULFUR ACTIVATION. D. F. Petersen (Los Alamos Scientific Lab., N. Mex.).

A method for estimating fast neutron doses from the $S^{32}(n,p)P^{32}$ reaction, modified to permit isolation of P^{32} from gross fission products, was used to analyze head and pubic hair specimens from the three victims of the SL-1 reactor accident. The neutron doses with energies above 2.5 Mev, as deduced from the measured P^{32} activities, are consistent with the positions of the victims at the time of the critical excursion. (D.L.C.)

1306 (LAMS-2627(p.73-81)) UPTAKE OF TRITIATED DEOXYNUCLEOSIDE PRECURSORS BY HeLa S-3 CELLS. D. F. Petersen, L. B. Cole, P. A. Hopkins, and P. C. Sanders (Los Alamos Scientific Lab., N. Mex.).

The mode of uptake of tritiated thymidine by HeLa S-3 cells was studied. The results show that early labeling of DNA closely follows the predicted time course. (D.L.C.)

1307 (LAMS-2627(p.82-93)) THE INFLUENCE OF INTRACELLULAR TRITIUM BETA IRRADIATION ON THE GROWTH OF HEMOPHILUS INFLUENZAE. D. F. Petersen, I. U. Boone, P. C. Sanders, L. B. Cole, and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

The effects of tritium-labeled thymidine, water, or unlabeled thymidine on the growth of Hemophilus influenzae were studied. Some reproductive killing of Hemophilus by tritiated thymidine and tritium water occurred, but the rate of tritium fixation in DNA failed to keep pace with cell growth. (D.L.C.)

1308 (LAMS-2627(p.94-8)) STUDIES ON DETECTION OF BIOLOGICAL EFFECTS OF MAGNETIC FIELDS. H. Foreman and M. C. Brooks (Los Alamos Scientific Lab., N. Mex.).

Experiments were made in an effort to detect biological effects of magnetic fields. Systems ranging from staph and HeLa cells to 1,1-diphenyl picrylhydrazyl were exposed to magnetic fields of 5,000 to 20,000 gauss for 1 hr to 7 days. It was not possible to demonstrate any effect with any degree of certainty. (D.L.C.)

1309 (LAMS-2627(p.99-101)) THE EFFECT OF PHYSICAL FACTORS ON TRANSFORMING PRINCIPLE (DNA) OF HEMOPHILUS INFLUENZAE. I. U. Boone and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

Exposure of Hemophilus-transforming DNA to temperatures as low as 4°K for 24 hr and to high magnetic field strengths of 16,000 gauss for one week had no effect on its transforming activity. (D.L.C.)

1310 (LAMS-2627(p.103-9)) REDUCED LIFE EXPECTANCY IN DESCENDANTS OF FIVE GENERATIONS OF X-IRRADIATED SIRES. J. F. Spalding and V. G. Strang (Los Alamos Scientific Lab., N. Mex.).

The average life span of the descendants of 5 generations of x-irradiated males was compared with that of control mice from a nonirradiated line having the same degree of inbreeding. In the x-irradiated line, all male mice were given 200 rads of x rays to the whole body at 28 days of age and mated to their nonirradiated sisters. The mean life span of males and females of the sixth generation of the x-irradiated line was 609 and 529 days, respectively, while that of control males and females was 755 and 620 days, respectively. (D.L.C.)

1311 (LAMS-2627(p.110-16)) EFFECT OF AGE ON ABILITY OF MICE TO SURVIVE FRACTIONATED RADIATION EXPOSURE. J. F. Spalding and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.).

Female mice of the RF strain were divided into 10 age groups (age range 2 to 21 months) and exposed to 450 rads of Co^{60} γ rays at 2-week intervals until death. The results, plotted on a median lethal dose (MLD) vs age graph, show that the MLD was relatively constant during the first half of the adult life and that a decline in radioresistance began at ~13 months which appeared to be linear with age. (D.L.C.)

1312 (LAMS-2627(p.117-20)) PROTECTION OF CFW SWISS MICE FROM POST IRRADIATION TRANSPLANTABLE AK LEUKEMIA BY PREIRRADIATION IMMUNIZATION. I. U. Boone and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

A series of experiments was performed in which groups of CFW Swiss female mice were immunized respectively with leukemic AKR spleen homogenate, with normal AKR spleen homogenate, and with nonspecific antigens. Groups of unimmunized mice were used as controls. All groups were then irradiated with x rays and the immunized groups and some of the controls challenged with AK leukemia. Lethality data collected at 12 and 30 days indicate that immunization with either leukemic or normal AKR spleen was equally effective in protecting against AK leukemia and that nonspecific immunization had no effect on leukemia "takes." (D.L.C.)

1313 (LAMS-2627(p.121-3)) THE EFFECT OF DOSE RATE ON THE INCIDENCE OF LEUKEMIA IN SEVERAL STRAINS OF MICE. I. U. Boone and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

Mice of three strains (C57B1, CFW Swiss, and RF) aged 8 to 16 weeks were given 50 rads/day of x rays 5 days a week until their total accumulated dose was 1500 rads. The mean survival times and life shortening as compared to nonirradiated control mice were measured. The measured life shortening ranged from 34% for RF female to 78% for C57B1 female. (D.L.C.)

1314 (LAMS-2627(p.124-6)) MAINTENANCE AT LOW TEMPERATURE OF SEVERAL TRANSPLANTABLE TUMORS. I. U. Boone and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

Three transplantable mouse tumors were preserved by quick freezing in 20% glycerol and storing at −70°C. The maximum survival time was 1.5 yr for Erhlich's ascites tumor, 5 months for L4946 leukemia tumor, and 2.5 yr for AKR leukemia tumor. HeLa cells from tissue culture were also preserved under the same conditions for at least 5 months. (D.L.C.)

1315 (LAMS-2627(p.127-36)) PRELIMINARY DATA ON NEUTRON AND GAMMA DEPTH DOSE RELATIONS WITH FISSION NEUTRONS USING A PLASTIC MAN PHANTOM. J. A. Sayeg and J. D. Perrings (Los Alamos Scientific Lab., N. Mex.).

Neutron and gamma dose vs depth distributions were measured in a plastic man phantom, using the Godiva critical assembly as the radiation source. The results are consistent qualitatively with the multiple collision Monte Carlo calculations. (D.L.C.)

1316 (LAMS-2627(p.137-44)) CALCULATION OF THE UNCERTAINTIES INVOLVED IN THE EVALUATION OF NEUTRON TISSUE DOSE BY THE THRESHOLD DETECTOR TECHNIQUE. J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.).

The reflected errors in neutron tissue doses measured with fission threshold detectors were evaluated for the case where the uncertainties of the measured neutron flux values are known. An experiment performed in the Godiva II critical assembly indicated that the B^{10} sphere in the fission detector may be replaced by a Cd shield. (D.L.C.)

1317 (LAMS-2627(p.145-9)) ADVANCEMENTS IN THE ELECTRONIC CIRCUITRY FOR THE LARGE H-4 FISSION GAMMA COUNTER. J. A. Sayeg, J. H. Larkins, and E. L. Carr (Los Alamos Scientific Lab., N. Mex.).

The conventional vacuum tube systems of the large gamma scintillation counter for foil counting of Pu^{239}, Np^{237}, and U^{238} were replaced with transistorized circuits. Revised calibration constants at 3 hr post irradiation are presented. (D.L.C.)

1318 (LAMS-2627(p.150-60)) NEUTRON CALIBRATION PROCEDURES EMPLOYED BY THE BIOMEDICAL RESEARCH GROUP. J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.).

Past thermal neutron flux determinations related to calibration studies are reviewed, and procedures now being used to calibrate neutron sources are described. (D.L.C.)

1319 (LAMS-2627(p.163-74)) LONG-TERM RETENTION OF RADIOCESIUM BY MAN. C. R. Richmond, J. E. Furchner, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.).

Whole-body retention data for Cs^{134} and Cs^{137} were obtained for four normal male subjects over periods ranging from 106 to 940 days. Retention of radiocesium was found to be described more accurately by the sum of two exponential components than by a single or composite power function, and the biological half time of the component with the smaller rate constant ranged from 110 to 147 days with a mean value of 135 days. (D.L.C.)

1320 (LAMS-2627(p.175-82)) ESTIMATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOISOTOPES IN WATER $(MPC)_w$ FROM INTERSPECIES CORRELATIONS. II. COMPARISON OF ESTIMATED AND MEASURED VALUES FOR CESIUM^{137}. C. R. Richmond, J. E. Furchner, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.).

Retention data were collected for radiocesium in mice, rats, monkeys, and dogs and extrapolated to man to yield the maximum permissible concentration (MPC) of Cs^{137} in water. The results are compared with other MPC values. (D.L.C.)

1321 (LAMS-2627(p.183-9)) RETENTION AND EXCRETION OF IODINE^{131}. I. IN MICE AFTER ORAL AND INTRAPERITONEAL ADMINISTRATION. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

The retention of I^{131} administered to mice by oral and intraperitoneal routes is compared by means of whole-body and urine and feces counting. The data were fitted to 3-component exponential equations. A difference between data for oral and intraperitoneal administration was found which indicates that I^{131} is not completely absorbed by the gut. (D.L.C.)

1322 (LAMS-2627(p.190-3)) RETENTION AND EXCRETION OF IODINE^{131}. II. IN RATS AFTER ORAL AND INTRAPERITONEAL ADMINISTRATION. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

The retention and excretion of I^{131} by rats after oral and intraperitoneal administration was measured over 50 days and found to fit 3-exponential equations. A small difference was found between the data for oral and intraperitoneal administration. (D.L.C.)

1323 (LAMS-2627(p.194-7)) RETENTION AND EXCRETION OF IODINE^{131}. III. IN MONKEYS AFTER ORAL ADMINISTRATION. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

The I^{131} activity of three male rhesus monkeys fed orally with I^{131} was assayed in a whole-body counter at 0.5 hr after administration and 5 times weekly thereafter for a period of 40 days. The retention data were found to fit a 2-component exponential function, with the first component having a half-time of 0.5 days and the long component a half-time of ~65 days. (D.L.C.)

1324 (LAMS-2627(p.198-203)) RETENTION AND EXCRETION OF IODINE^{131}. IV. IN DOGS AFTER ORAL ADMINISTRATION. C. R. Richmond, J. E. Furchner, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Four male beagle hounds were fed I^{131} and counted at intervals up to 42 days. The retention data were found to fit a 2-component exponential function, with the respective half-times of the components being 1.3 and 17.5 days. (D.L.C.)

1325 (LAMS-2627(p.204-12)) RETENTION AND EXCRETION OF IODINE^{131}. V. INTERSPECIFIC CORRELATIONS AND MAXIMUM PERMISSIBLE CONCENTRATIONS. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Parameters of the retention functions of administered I^{131} in laboratory animals are extrapolated to give the I^{131} equilibrium level in man. The extrapolated equilibrium level and maximum possible concentration in water are in good agreement with those derived from experimental measurements on human subjects. (D.L.C.)

1326 (LAMS-2627(p.213-18)) RETENTION AND EXCRETION OF RUTHENIUM^{106} BY MICE. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Ru^{106} chloride was administered intraperitoneally to 12 RF_1 female mice and their activity determined at intervals up to the 432nd day after administration. The retention data were found to fit a 4-component exponential equation. (D.L.C.)

1327 (LAMS-2627(p.220-2)) FALLOUT LEVELS OF CESIUM^{137} IN UNITED STATES MILK AS INFLUENCED BY FEEDING PRACTICES. G. M. Ward (Los Alamos Scientific Lab., N. Mex.).

Quarterly measurements of Cs^{137} levels in nonfat dry milk solids from 34 locations in U. S. are reported for 1957 to 1960. Variations which cannot be explained by amounts of fallout or precipitation may be related to prevalent forage type in an area. The highest Cs^{137} levels found are less than 0.001 of the maximum permissible concentration for Cs^{137}. (D.L.C.)

1328 (LAMS-2627(p.223-5)) VARIATION OF THE CESIUM^{137} CONTENT OF NEW MEXICO RESIDENTS AS A FUNCTION OF TIME. E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

Data on the quarterly average Cs^{137} content of New Mexico residents for the period 1956 to 1959 are extended through the second quarter of 1961. The results indicate that a maximum was reached in the Cs^{137} content at the beginning of 1960 but that the decline thereafter was not steady. The results are compared with data for a German population. (D.L.C.)

1329 (LAMS-2627(p.226-33)) RADIOACTIVITY OF NEVADA CATTLE: 1959. M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.).

In a study of the effects of Nevada Test Site atomic bomb tests on Nevada cattle as compared with cattle from other locations, soft tissue (muscle and liver) radioactivity measurements are reported for Cs^{137}, Zn^{65}, and K^{40}. The results are largely similar to data for other cattle, with the exception of Zn^{65}, which was ~4 times higher in Nevada cattle. A plot of the 1957 to 1959 data on Cs^{137} in muscle shows a maximum in the fall of 1958, which corresponds with the large number of tests in 1958. (D.L.C.)

1330 (LAMS-2627(p.234-7)) A DOUBLE SODIUM IODIDE (THALLIUM) CRYSTAL GAMMA RAY DETECTOR. M. A. Van Dilla and M. W. Rowe (Los Alamos Scientific Lab., N. Mex.).

A description is presented of a gamma ray detector for small samples, e.g., mice, consisting of two 8 × 4 in. NaI(Tl) crystals facing each other. (D.L.C.)

1331 (LAMS-2627(p.238-59)) RADIOCARBON IN CONTEMPORANEOUS PLANT PRODUCTS. V. N. Kerr, F. N. Hayes, E. Hansbury, and D. L. Williams (Los Alamos Scientific Lab., N. Mex.).

Data are reported for the C^{14} content of selected essential oils collected from over 40 locations and covering a time span of ~50 yr. Seasonal variations were found to occur regularly in the C^{14} content of the oils, but increases were also found which are in accord with measurements of others on air, CO_2, and plant products. The data suggest a north-to-south latitudinal effect in the Northern Hemisphere and a stratospheric mixing time of less than 1 yr. The variations of C^{14} content between different plant species harvested at the same time are postulated to be due to metabolism differences. (D.L.C.)

1332 (LAMS-2627(p.263-9)) METABOLISM OF ZINC^{65} IN A TERMINAL LEUKEMIA CASE. C. R. Richmond, C. C. Lushbaugh, M. W. Rowe, and M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.).

The whole-body retention of Zn^{65} by a 15-year-old girl with chronic myelogenous leukemia was measured at intervals up to 137 days after Zn^{65} administration, at which point death occurred; the distribution of Zn^{65} was determined in selected tissues after death. The retention data suggest more rapid Zn^{65} turnover by the leukemia patient than by normal subjects. Highest Zn^{65} concentrations in the tissues were found in the muscle and liver. (D.L.C.)

1333 (LAMS-2627(p.270-9)) CLINICAL APPLICATIONS OF WHOLE BODY SCINTILLOMETRY. V. EQUILIBRATION RATES OF RAT AND MAN WITH ENVIRONMENTAL IODINE. C. C. Lushbaugh and D. B. Hale (Los Alamos Scientific Lab., N. Mex.).

A study was made of the retention of I^{131} by rats fed intraperitoneally with I^{131} and the equilibration results compared with those for man. The unbound iodide turnover is similar for both rats and man, whereas the kinetics of bound iodide is quite different in the two species. (D.L.C.)

1334 (LAMS-2627(p.280-3)) CLINICAL APPLICATIONS OF WHOLE BODY SCINTILLOMETRY. VI. DETERMINATION OF COBALT^{60} VITAMIN B$_{12}$ ABSORPTION AND RETENTION. C. C. Lushbaugh and D. B. Hale (Los Alamos Scientific Lab., N. Mex.).

Whole-body retention of Co^{60}-labeled vitamin B$_{12}$ was studied in 3 normal persons and one patient with severe degenerative disease of the posterio-lateral columns of the spinal cord. Each person was given labeled B$_{12}$ orally and, 1 hr later, nonlabeled B$_{12}$ intramuscularly as a flushing dose and counted at intervals up to one month. The retention of Co^{60} by the normals was much more tenacious than for the patient, with respective half-times being 245 and 20 days. The 24-hr urine samples indicated an absorptive defect in the patient. (D.L.C.)

1335 (LAMS-2627(p.284-90)) EXPERIMENTAL IODIDE BLOCKADE OF IODINE^{131} THYROID UPTAKE IN RATS. D. B. Hale and C. C. Lushbaugh (Los Alamos Scientific Lab., N. Mex.).

The effects of time and size of inert iodine dosage upon thyroidal iodine binding were investigated in rats using intraperitoneal NaI^{131} injections. The results indicate that significant suppression of I^{131} binding can be obtained with a small dose of inert iodide administered anywhere from 8 hr before to 8 hr after exposure to I^{131}, with maximum suppression occurring for a dose 2 hr before exposure. (D.L.C.)

1336 (LAMS-2627(p.291-7)) PROGRESS IN REFINEMENT OF THE WHOLE BODY COUNTING TECHNIQUE FOR DETERMINING THYROID UPTAKE. C. C. Lushbaugh (Los Alamos Scientific Lab., N. Mex.).

Studies were conducted in order to develop techniques for allowing for errors in whole-body measurements of I^{131} activity. The counting efficiency of the Humco I counter was found to fall off at both ends. A method for making standard measurements was evolved which uses a sugar phantom. (D.L.C.)

1337 (LAMS-2627(p.300-9)) VETERINARY SERVICES. (Los Alamos Scientific Lab., N. Mex.).

Devices and modifications adapted in the care and feeding of laboratory animals are described. An inventory of the LASL animals is included. (D.L.C.)

1338 (ORNL-3189(p.191-7)) ESTIMATION OF INTERNAL DOSE. W. S. Snyder (Oak Ridge National Lab., Tenn.).

A formula for estimating body burdens of Pu from urinary excretion data was derived and programmed on the IBM 7090 computer. The formula demands data for urinary excretion as a continuous function of time. Although the values of the urinary excretion are known only at discrete times, these are regarded as sample values, and the continuous case is obtained by a linear interpolation. Several methods of interpolating were explored, and thus far no substantial difference in the estimates of retention has resulted. An MPC$_w$ for Rn^{222} was estimated from the data available in the literature and compared with naturally occurring levels. It is indicated that a level of 5×10^{-6} μc/cc delivers 3 millirems per week to yellow marrow, which, if considered in the same category as the bloodforming organs, is the critical organ. An MPC$_a$ for insoluble Ra^{226} compounds was calculated. An experimental measurement of the retention of Ra^{226} daughter products in lung tissue was required, and even though no adequate experimental data could be found, some estimates of the greatest and least retention, which bracketed the most reasonable retention, were made. The values corresponding to these two estimates were 1×10^{-10} μc/cc and 5×10^{-11} μc/cc (40-hr occupational exposure), different from each other by a factor of only 2. The lower value was recommended for application pending more experimental data. (auth)

1339 (ORNL-3189(p.234-5)) ESTIMATION OF FAST NEUTRON DOSE TO MAN BY THE ANALYSIS OF HAIR FOR P^{32}. L. B. Farabee and W. T. Thornton (Oak Ridge National Lab., Tenn.).

A method is being evaluated for estimating fast-neutron dose (>2.5 Mev) by the analysis of hair samples for P^{32}. The analysis of body hair can provide valuable supplementary information with regard to the dose from fast neutrons, and, also, it can give an indication of the orientation of the person during exposure. Samples of hair were attached in the appropriate locations on four man-simulating phantoms, and these assemblies were exposed to a field of mixed neutron and gamma radiation at the Tower Shielding Reactor. There is excellent agreement, down to about 5 rads, between the fast-neutron dose estimated from a 1-g sample of hair compared with the analysis of large sulfur pellets located near the packets of hair during exposure. For phantoms facing the reactor, the average front-to-back ratio was about 10. Studies now under way are aimed at improving the discrimination against possible fission product contamination on the hair. (auth)

1340 (UCRL-9862) RED CELL MASS AND LIFE SPAN IN THE RAT DURING PERIODS OF PHYSIOLOGICAL HYPERTRANSFUSION (thesis). Howard Gilbert Parker (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 15, 1961. Contract W-7405-eng-48. 64p.

A double isotope method for simultaneous measurement of red cell and plasma volumes was developed for use in the rat. The DFP^{32} red cell life span method was also adapted to use in the rat, involving test and comparison of three different injection and sampling techniques. The above measurements, plus Fe^{59} incorporation, were used in various combinations to obtain data on rats in the following physiological states: normal adult male and female rats, hypophysectomized and acutely starved rats, male and female rats reacclimatizing to sea level after a prolonged exposure to simulated high altitude, and male rats exposed to hyperoxia (50% oxygen) for periods up to 1 month. In none of these conditions of "physiological hypertransfusion" was there evidence for a rapid or random destruction or "erythrolysis" in response to the body's decreased needs for erythrocytes. Other physiological results are also discussed. (auth)

1341 THE GROWTH OF ALGAE IN D$_2$O DEUTERIUM OXIDE. William Chorney, Norbert J. Scully, Henry L. Crespi, and Joseph J. Katz (Argonne National Lab., Ill.). Biochim. et Biophys. Acta, 37: 280-7(Jan. 15, 1960). (In English)

The experiments described indicate that algae grow and divide in a medium containing more than 99% D$_2$O. After an inhibition period both *Chlorella* and *Scenedesmus* grew and divided, and after growth was established showed only a small percentage of abnormally large cells. The development of improved nutrient media for deuterated organisms is discussed. Deuterated compounds other than sugars were isolated from algae. It may be possible to use deuterated algae as such as a substrate for the growth of organisms that would give high yields of specific compounds such as amino acids, nucleic acids, and antibiotics. Simultaneous labeling with C^{14} could also be accomplished. With the successful culture of algae in deuterated media the way is open for a considerable variety of experiments involving deuterium and its biological effects. (auth)

1342 THE SPECIFICATION OF TREATMENT CONDITIONS AND SOURCE REQUIREMENTS FOR COBALT 60

THERAPY UNITS. F. Ellis and R. Oliver (Churchill Hospital, Oxford). Brit. J. Radiol., 34: 720-5(Nov. 1961).

The criteria for the choice of source size and radiation conditions for a Co^{60} therapy unit are considered. It is concluded that the S.S.D. should be between the limits 60 to 80 cm with a dose-rate of 50 to 150 rads/min. The effect of source dimensions on penumbra and of self absorption loss on source efficiency with practicable specific activities are discussed, and suggestions made for an optimum source suitable for use in three successive types of unit as the activity falls. (auth)

1343 DATA FROM THE STUDY OF SOIL AND PLANT SAMPLES IN THE REGION OF THE TUNGUS METEOR CRASH OF 1908. A. V. Zolotov (Volga-Urals Branch, All-Union Scientific Research Inst., USSR). Doklady Akad. Nauk S.S.S.R., 140: 103-6(Sept. 1, 1961). (In Russian)

Samples taken at various distances from the epicenter of the 1908 Tungus meteor crash showed an apparent decrease in radioactivity with increasing distance from the point of impact. However, an analysis of the beta energies showed the presence of K^{40}, Sr^{90}–Y^{90} and Ce^{144}–Pr^{144}. Most of the activity was shown to have a half-life of about one year (the activity of control samples decreased by 30% in 5 months). It was found that fall-out due to recent nuclear testing contaminated dead wood more heavily than the wood in living trees, and the radioactivity of samples taken under the same conditions showed no relationship to the distance from the epicenter of the meteor crash. However, a study of the radioactivity of growing trees from various regions of the Urals and Siberia revealed the interesting fact that the annual growth rings in certain trees are a sensitive indicator of the increase in radioactivity and of the time of contamination of a locale with radioactive fall-out. The activity of the inner rings is due to potassium, and that of the outer rings is due to fission products. Thus, a 60 year old pine tree from the Urals showed a sharp increase in activity in 1949 due to fall out from nuclear testing. A 250 year old pine tree from the region of the Tungus meteor crash of 1908 showed a sharp increase in radioactivity in 1908 as well as in 1949. Moreover, the width of the annular growth rings of the trees increased by a factor of five after 1908 as compared with previous years. It is concluded that this rapid increase in the rate of growth was a direct result of the Tungus meteor crash. (TTT)

1344 USE OF NEUTRON ACTIVATION ANALYSIS FOR STUDYING STABLE IODIDE UPTAKE BY THE THYROID. Henry N. Wagner, Jr., Wil B. Nelp, and James H. Dowling (Johns Hopkins Univ., Baltimore and U. S. Naval Hospital, Bethesda, Md.). J. Clin. Invest., 40: 1984-92 (Nov. 1961).

A technique of neutron activation analysis was used to measure trace quantities of inorganic iodide in urine. Anion exchange resins and selective elution permitted removal of interfering sodium and chloride from urine prior to the activation procedure. The uptake of stable iodide by the thyroid was determined by measuring the radioiodine uptake and specific activity (I^{131}/I^{127}) of simultaneously excreted urine. In 34 fasting euthyroid subjects the mean iodide uptake by the thyroid was 3 ± 2 μg per hour. Plasma concentration of inorganic iodide averaged 0.005 μg per ml. Day to day variations in iodide intake resulted in corresponding variations in the amount of stable iodide accumulated by the thyroid, since iodide accumulation approximated a first-order reaction. Prolonged administration of exogenous iodide resulted in a gradual decrease in radioiodine accumulation. This resulted in a decreased accumulation of stable iodide only after several weeks of greatly increased iodide uptake by the thyroid. A mechanism postulated to explain the dynamics of iodide accumulation by the thyroid is presented. (auth)

1345 AUTORADIOGRAPHY USING MELTED NUCLEAR EMULSION. A. C. Kulangara (Carnegie Institution of Washington, Baltimore). Nature, 192: 437-9(Nov. 4, 1961).

During an investigation of rabbit uterus (labeled with C^{14}) by the method of staining first, coating with nitrocellulose and emulsion, and then processing, it was found that sections became de-stained in spite of considerable overstaining, and black deposits, ranging from a few silver grains to large aggregates, appeared on slides. Discrete grains, indistinguishable from those caused by ionizing events, occurred in greater density near the aggregates. Observations are reported which indicate that stains may be involved in the formation of artefacts when a thin nitrocellulose film is used and that artefacts as well as bleaching of stains may be prevented by embedding sections in a hydrophobic layer. Discussion is given on both strain and chemically induced artefacts, and also on protective coatings. (P.C.H.)

1346 THE DOMINION X-RAY & RADIUM LABORATORY. (New Zealand. Dominion X-Ray and Radium Lab., Christchurch). [1961]. 39p.

The Dominion X-Ray and Radium Laboratory is concerned with the protection of the people of New Zealand from radiation hazards. The services provided by the Laboratory are available free to all licensees. An organizational chart of the Laboratory is presented and services are described. (C.H.)

1347 RADIOACTIVE ISOTOPES IN PHYSIOLOGY, DIAGNOSTICS, AND THERAPY. VOLUMES I AND II. H. Schwiegk and F. Turba, eds. Second Revised and Enlarged Edition. Berlin, Springer-Verlag, 1961. 1369p., Vol. I; 1267p., Vol. II.

A comprehensive bibliographic survey is made of the utilization of radioisotopes in physiology, diagnosis, and therapy. The two-volume presentation is divided into three parts. The first part deals with the general, physical, chemical, and biological bases of work with isotopes. In the second part radioisotopes for investigations in physiology, pharmacology, and diagnosis are reviewed. Therapy with radioactive isotopes are considered in the third part. The two volumes are divided into 83 major sections. Separate abstracts have been prepared for 80. (J.S.R.)

1348 GENERAL INFORMATION ON RADIOACTIVE ISOTOPES. Kurt Schmeiser. p.1-120 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A discussion on the basic properties of radioisotopes is divided into two parts—physical properties and measurements on radioactive substances. In the first section the topics discussed are stable and unstable isotopes, preparation of artificial radioisotopes, passage of electrons through matter, passage of γ radiation through matter, fundamental principles of measurement devices for the detection of radiation, radioactive decay, and accuracy of radioactive measurements. In the section on measurements on radioactive substances the topics reviewed are β measurements on solid preparations, absolute measurements with special methods, measurement of radioactive substances in liquid form, measurement of gaseous radioactive substances, detection of γ radiation, measurement of thin preparations of energy-poor β emitters, and activation analysis. (J.S.R.)

1349 THE INDIVIDUAL ISOTOPES AND PECULIARITIES OF THEIR DETERMINATION. Guenter Herrmann. p.121-304 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

As an introduction to the discussion of the individual isotopes and their determination, chemical and radiochemical methods for work with isotopes are reviewed. The selection and preparation of isotopes for a given problem, extension of biological probes to activation measurements, and preparation of probes for activation measurements are described. Individual isotopes discussed are those of carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur, halogens, alkali metals, alkaline earth metals, chromium, manganese, iron, cobalt, copper, and zinc. The half life, preparation, specific activity, chemical purification, and determination of the radioisotopes of all the other elements are tabulated. (J.S.R.)

1350 DETERMINATION OF TRITIUM IN BIOLOGICAL MATERIAL. Elwood von Jensen. p.305-10 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A method for the determination of tritium in blood, tissues, and organic compounds was developed which effects a reasonable compromise between time and labor on the one hand and accuracy and general applicability on the other. In the procedure dried blood or tissue samples are converted to water, carbon dioxide, and nitrogen by heating with copper and copper oxide at 650° in sealed tubes with breakoff tips. The tubes are broken in an evacuated apparatus and the tritiated water is distilled into a cold trap containing a definite amount of ordinary water. After adding ethanol and a fluor solution, the radioactivity is determined in a scintillation counter. The accuracy and reproducibility of the method are good. A step-wise procedure for the determination is given. (J.S.R.)

1351 DETECTION OF STABLE ISOTOPES. Helmut Liebl. p.311-20 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

The reasons for the utilization of stable isotopes as indicators are briefly reviewed. For the evaluation of the mass frequency of a given stable indicator, mass spectrometers or spectrographs are used. The three essential stages in mass spectroscopy—ion production, mass separation, and ion detection—are each briefly described. The mass spectra to be analyzed for the detection of hydrogen, carbon, nitrogen, and oxygen are summarized, and the steps in the evaluation of the spectra obtained are indicated. (J.S.R.)

1352 AUTORADIOGRAPHY. Eberhard Harbers. p.321-52 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A review of autoradiography techniques is given. The physical principles of autoradiography are first given. Then the methods used and the preparation of tissue for such studies are considered. Quantitative evaluation of the emulsions is briefly reviewed. An indication of data obtainable from autoradiography is presented. (J.S.R.)

1353 ASPECTS OF THE BIOLOGICAL EFFECTS OF RADIATION. L. F. Lamerton. p.353-74 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

As an introduction to a review of the biological effects of radiation, the physical interaction of radiation and matter are considered. The principal topics discussed are the mechanism of cytological effects of radiation, problems of tissue response with respect to fractionation and protraction of radiation, and radiation-induced malignancy. (J.S.R.)

1354 MEDICATION CARRIER MODIFICATION OF RADIATION DAMAGE. Alexander Catsch. p.393-404 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A brief review is made of the medications used as protective agents and therapeutic substances. (J.S.R.)

1355 THERAPEUTIC POSSIBILITIES IN INCORPORATION OF RADIOISOTOPES. Alexander Catsch. p.405-16 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

The various drugs and medications used for therapy of the damages suffered from incorporation of radioisotopes are briefly reviewed. (J.S.R.)

1356 THE MAXIMUM PERMISSIBLE RADIATION BURDEN. Gerhard Schubert, Guenter Hoehne, and Hans A. Kuenkel. p.417-39 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

Uncertainties in the knowledge of the genetic and somatic effects of radiation, which cause imprecision in the establishment of the maximum permissible radiation burden, are discussed. The units defining dose and dose output are given, and the maximum permissible dose for whole-body and partial-body exposure is reviewed. The radiation burden resulting from the incorporation of radioactive substances is then discussed. A tabulation of the maximum permissible concentration of radioisotopes in drinking water and air is given. (J.S.R.)

1357 RADIATION PROTECTION. Otto Hug and Hermann Muth. p.440-83 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

The report is limited to a discussion of the basic principles of radiation protection in the vicinity of radioisotopes, some organizational and personnel postulates, principles and practices in radiation protection measurements, and the health physics monitoring of personnel in radiation laboratories. (J.S.R.)

1358 CONSTRUCTION AND EQUIPMENT OF A NUCLEAR MEDICAL SECTION. Hans Goette and H. A. E. Schmidt. p.484-535 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

Special considerations that must be taken into account in the construction and furnishing of a nuclear medical center are described. The design, constructional peculiarities, and apparatus of such a center are reviewed. Firms manufacturing items for a nuclear medical center are tabulated. (J.S.R.)

1359 HISTORICAL REVIEW OF THE UTILIZATION OF ISOTOPE TRACERS. Georg von Hevesy. p.536-70 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A historical review is given of the development of the utilization of isotope tracers. All the works published up to 1946 are cited, but then only the publications of new methods for the utilization of radioactive isotopes are given. The elements discussed as tracers are hydrogen, phosphorus, carbon, sodium, potassium, rubidium, cesium, calcium, strontium, barium, rare earths, americium, zirconium, vanadium, manganese, chromium, niobium, tantalum, molybdenum, rhenium, iron, platinum metals, cobalt, nickel, silver, gold, beryllium, magnesium, zinc, cadmium, mercury, gallium, indium, nitrogen, arsenic, antimony, oxygen, sulfur, selenium, tellurium, fluorine, chlorine, bromine, iodine, astatine, and the rare gases. (J.S.R.)

1360 PREPARATION OF ISOTOPE-LABELLED COMPOUNDS. Hans Griesbach. p.571-90 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

The preparation of labeled compounds is reviewed with a discussion of the various methods used. The purity criteria of labeled compounds are given, and the methods used to obtain the desired purity are described. Then the positioning of the isotopes at specific sites in the organic molecule and the determination of the efficiency of the reaction course are reviewed. (J.S.R.)

1361 SOME GENERAL REMARKS ON THE APPLICATION OF ISOTOPE INDICATORS. Georg von Hevesy. p.591-5 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

Isotope indicators make it possible to follow the paths of atoms, molecules, or larger units, and perhaps the forming elements of blood in living organisms. Brief discussions are given of cases in which tracers are not necessary, problems which can be solved only with tracers, labeling of cells, labeling of entire organisms, and origin determination of body constituents and determination of reaction paths. (J.S.R.)

1362 THE MATHEMATICAL TREATMENT OF METABOLIC PROCESSES. Herman Branson. p.596-618 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A metabolizing system, in this discussion on the mathematical treatment of metabolic processes, is considered as an intact living biological specimen, a part of such a specimen in vitro, or purified enzymes derived from biological specimens used with appropriate substrates in vitro. Although it is assumed in some discussions that the use of isotopes as tracers is an extension of the analytical method for the analysis of biological reactions, and therefore that all mathematical methods used over the years would be applicable, in the present article, the discussion is limited to illustrating the mathematical methods that have proved of greatest utility in interpreting data secured from metabolizing systems through the use of isotopes. (J.S.R.)

1363 ISOTOPES AS A TOOL IN BIOCHEMICAL ANALYSIS. J. K. Whitehead. p.619-38 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

Stable and radioactive isotopes are being used on an increasing scale in an attempt to overcome some of the analytical difficulties inherent in conventional procedures. Isotopic techniques used in analytical problems fall into three groups: isotope dilution analysis, isotope derivative analysis, and activation analysis. These three types of analysis are described and the applicability of each, with a discussion of the advantages and disadvantages, are reviewed. (J.S.R.)

1364 RADIOACTIVE ISOTOPES IN THE STUDY OF THE PASTEUR AND CRABTREE EFFECTS. Alan C. Aisenberg. p.639-43 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

The essential feature of the Pasteur effect is the inhibition under aerobic conditions of the fermentative breakdown of sugar (glycolysis); that of the Crabtree effect is the small (10 to 12%) suppression of respiration of rat and mouse tumors as a result of the addition of glucose, but not non-metabolyzable xylose. A brief review is given of the utilization of radioisotopes in the study of the mechanism of these two effects. (J.S.R.)

1365 THE USE OF ISOTOPES IN THE STUDY OF SUGAR TRANSPORT IN MAMMALIAN CELLS AND TISSUES. Ernst Helmreich (Washington Univ., St. Louis and Barnard Free Skin and Cancer Hospital, St. Louis) and Robert K. Crane. p.644-65 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

In permeability studies, there are problems which cannot be approached without the use of isotopes. In order to emphasize those instances for which isotopic techniques are especially suitable, the fundamental problems of sugar transport are outlined and other experimental means for their solution are discussed. The use of isotopes for analysis is then reviewed, and some examples of the use of isotopes in the study of sugar transport are given. (J.S.R.)

1366 RADIOACTIVE ISOTOPES IN INVESTIGATIONS ON THE CITRIC ACID CYCLE. August Holldorf and Helmut Holzer. p.666-704 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

In the study of the citric acid cycle and carbon isotopes C^{11}, C^{13}, and C^{14}, the hydrogen isotopes H^2 and H^3, P^{32}, and S^{35} have found application. The experimental techniques and results are reviewed. The topics discussed are studies on individual reactions and the sequence of the citric acid cycle, the occurrence of the citric acid cycle in various organisms, the citric acid cycle as intermediate or initial agent for the synthesis of cellular substances, the maintenance of the citric acid cycle, and variants of the citric acid cycle. (J.S.R.)

1367 THE USE OF GLUCOSE-^{14}C IN THE STUDY OF THE PATHWAYS OF GLUCOSE METABOLISM IN MAMMALIAN TISSUES. Joseph Katz. p.705-51 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A review is given on the present knowledge of glucose metabolism in mammalian tissues. The purpose of the review is to discuss the assumptions underlying the use of C^{14} glucose for the evaluation of the pathways of glucose metabolism, to recapitulate and review the published information on the subject, and to suggest new methods and procedures for the quantitative determination of the pathways of glucose metabolism. (J.S.R.)

1368 METABOLISM OF FATTY ACIDS AND FATS. Konrad Lang. p.752-72 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A review is given on the present knowledge of the metabolism of fatty acids and fats. Topics reviewed are the resorption of fats, removal of lipids from the blood, accumulation of fat, synthesis of fatty acids, biosynthesis of fat, and variations in the metabolism of individual fatty acids. (J.S.R.)

1369 THE METABOLISM OF PHOSPHATIDES AND RELATED MATERIALS. Hildegard Debuch. p.773-803 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

Glycerinphosphatides and sphingomyelin are included in the general category of phosphatides, phosphorus-containing lipoids. As the structures, physical properties, position in the organism, and biological significance of these two phosphatides differ clearly from each other, their chemical structure, metabolism, and biosynthesis are reported separately. (J.S.R.)

1370 METABOLISM OF STEROLS AND STEROIDS (WITH THE EXCEPTION OF THE STEROID HORMONES). Hans Machleidt and Rudolf Tschesche. p.804-27 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

In the review of the metabolism of sterols and steroids the biosynthesis of cholesterol and other steroids are discussed. Then the catabolism of cholesterol is summarized. (J.S.R.)

1371 METABOLISM OF AMINO ACIDS AND PROTEIN. H. Tarver and M. Rothstein. p.828-919 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

Aspects of amino acid biosynthesis and catabolism which have been approached by the use of radioisotopes are reviewed. In the section on amino acids an endeavor was made to present a reasonably complete picture with respect to both anabolism and catabolism. With respect to protein synthesis and degradation, however, the approach is to indicate briefly how these problems are attacked by using isotopic methods. (J.S.R.)

1372 METABOLISM OF N AND S METHYL GROUPS. Wilhelm R. Frisell and Cosmo G. Mackenzie. p.920-44 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

Some aspects of the current knowledge of the metabolism of methyl groups in mammals which have been revealed through the use of isotopes are summarized, and the criteria that should be employed in interpreting isotope experiments are discussed. The discussion is divided into four parts: transmethylation and methyl carbon transfer, methyl oxidation and the production of formaldehyde and formate, the biosynthesis of methyl groups, and isotope effects in the metabolism of methyl groups. (J.S.R.)

1373 THE USE OF ISOTOPE TECHNIQUE IN STUDIES OF PURINE AND PYRIMIDINE METABOLISM. Charles E. Carter. p.945-59 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

The application of isotope techniques to some problems of contemporary importance in purine and pyrimidine metabolism is discussed. Current investigations are emphasized. (J.S.R.)

1374 ENZYMATIC SYNTHESIS OF RIBONUCLEIC ACID. Severo Ochoa. p.960-73 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

The only enzymes so far discovered capable of catalyzing net synthesis of RNA and other polyribonucleotides is polynucleotide phosphorylase. The properties, mode of action, and distribution of this enzyme are reported. The structure and properties of synthetic polynucleotides are briefly reviewed. (J.S.R.)

1375 USE OF RADIOACTIVE ISOTOPES IN THE ENZYMATIC SYNTHESIS OF DNA. Arthur Kornberg. p.974-8 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A review is made of techniques involving the use of isotopes which have been valuable in the studies of the enzymatic synthesis of DNA. Topics discussed are assays of enzymes, linkage of single desoxynucleotides to the desoxynucleoside ends of DNA, incorporation of pyrimidine and purine analogs into DNA, analysis of the chemical composition of enzymatically synthesized DNA, and frequencies in nearest neighbor dinucleotide sequences in DNA and their replication. (J.S.R.)

1376 THE BIOSYNTHESIS OF PORPHYRINS. David Shemin (Columbia Univ., New York). p.979-1000 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A summary is given of some of the work done over the last ten years on the biosynthesis of porphyrins. The review is not exhaustive, but attempts to develop and describe those experiments which have uncovered the precursors of the porphyrin molecule and those which have established the relationship of its synthesis to other metabolic events occurring in the cell. (J.S.R.)

1377 ISOTOPES IN INVESTIGATIONS ON VITAMINS. Claus von Holt and Hellmuth C. Heinrich. p.1001-1141 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A review is given of the knowledge of vitamins gained by the use of radioisotopes. The labeling, synthesis, and metabolism of vitamins A, D, E, K, C, B_1, B_2, and B_{12} and nicotinic acid amide are summarized. (J.S.R.)

1378 APPLICATION OF RADIOACTIVE ISOTOPES TO ENZYME RESEARCH. Kurt Wallenfels and Horst Sund (Nobel Inst., Stockholm). p.1142-85 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

In a summary of the application of radioisotopes to enzyme research, emphasis is given to three relatively new areas of study: the clarification of the reaction mechanisms of enzyme reactions on the basis of organic chemical reaction mechanisms, the question of the enzyme substrate complexes occurring intermediately in nature, and the investigation on the chemical mechanism and the hereditary establishment of specific protein syntheses. (J.S.R.)

1379 PROTEOHORMONES. Peter Karlson. p.1186-8 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

The number of investigations on proteohormones carried out with tracers is limited, chiefly because the biochemistry of these substances is still descriptive. Tracer studies on biosynthesis, distribution in the organism, and decomposition are summarized. (J.S.R.)

1380 METABOLISM OF ADRENALINE AND RELATED COMPOUNDS. Richard W. Schayer. p.1189-96 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

A review is given of radioisotope studies on the formation and catabolism of adrenaline and related compounds. Problems for the future are briefly indicated. (J.S.R.)

1381 BIOCHEMISTRY OF THE THYROID HORMONES. Jean Roche and Raymond Michel. p.1197-1222 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

A summary is given of the results of radioisotopic studies on the chemistry, biosynthesis, and metabolism of thyroid hormones. Experimental data are related to the techniques by which they were obtained: separation of labeled bodies by paper and column chromatography, autoradiography, radiochromatoelectrophoresis, and synthesis of labeled molecules. (J.S.R.)

1382 STEROID HORMONE METABOLISM. Ralph I. Dorfman. p.1223-41 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In English)

Representative steroid hormone metabolism studies which have been dependent on radioisotopes are summarized to give a condensed unified picture of the field. The biosynthesis and catabolism of the steroid hormones are discussed. (J.S.R.)

1383 ISOTOPES IN INVESTIGATIONS OF MINERAL AND WATER CONSERVATION (IN ADDITION TO HEAVY METALS AND TRACE ELEMENTS). Hans Netter. p.1242-1327 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume I." Berlin, Springer-Verlag, 1961. (In German)

As an introduction to a review of isotope studies on water and mineral conservation in the body, the significance of the physical-chemical system, body fluids/cells and H_2O/electrolytes, is discussed. Then water and mineral exchange studies with radioisotopes are summarized. (J.S.R.)

1384 BERYLLIUM. H. P. Wolff and R. Fischer. p.1-4 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies of the uptake, metabolism, and excretion of Be are summarized. The mechanism of the efficiency of various compounds in the therapy of Be poisoning is reviewed. (J.S.R.)

1385 YTTRIUM. H. P. Wolff and R. Fischer. p.5-9 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies of the distribution of yttrium in the blood, liver, and skeleton and the effects of various compounds on this distribution are summarized. (J.S.R.)

1386 STRONTIUM. H. P. Wolff and R. Fischer. p.10-20 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies of the uptake, metabolism, and elimination of strontium are summarized. The effects of various carriers on the uptake and excretion are reviewed. (J.S.R.)

1387 FLUORINE. H. P. Wolff and R. Fischer. p.21-6 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the distribution of fluorine in blood and organs and its resorption and elimination are summarized. (J.S.R.)

1388 CHLORINE. H. P. Wolff and R. Fischer. p.27-32 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies made on the distribution space, exchange rate, and elimination of chlorine were summarized. (J.S.R.)

1389 BROMINE. H. P. Wolff and R. Fischer. p.33-40 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

As bromine serves no physiological metabolic function, it is used for the labeling of various compounds whose behavior in the body needs clarification. Such tracer studies as the permeability of nerve cells for bromide and other ions, determinations of extracellular liquid volume, and the dispersion of bromine in various organs are summarized. (J.S.R.)

1390 COPPER. H. P. Wolff and R. Fischer. p.41-54 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the physiological necessity of trace amounts of copper are summarized. The use of tracer techniques for physiological and pathological studies of copper distribution are also reviewed. (J.S.R.)

1391 SILVER. H. P. Wolff and R. Fisher. p.55-8 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the utilization of radiosilver for the detection of foci of infection and tumor sites are summarized. (J.S.R.)

1392 GOLD. H. P. Wolff and R. Fischer. p.59-67 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The increasing therapeutic utilization of Au^{198} is based on a series of investigations on the uptake and distribution of gold in organisms. Tracer studies on the distribution and on the factors affecting it are summarized. (J.S.R.)

1393 ZINC. H. P. Wolff and R. Fischer. p.68-79 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Studies showing the biological necessity of zinc are briefly reviewed. Tracer studies on organ uptake, distribution, and elimination of zinc and on incorporation into normal and diseased tissues are summarized. (J.S.R.)

1394 MERCURY. H. P. Wolff and R. Fisher. p.80-5 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies are summarized on the pharmacodynamic properties of the many mercury diuretics used, their working mechanisms, their duration in the various tissues, and their method of elimination. (J.S.R.)

1395 GALLIUM. H. P. Wolff and R. Fischer. p.86-91 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the metabolism, distribution, and excretion of gallium are summarized. The utilization of gallium for the detection of bone tumors is also briefly reviewed. (J.S.R.)

1396 HAFNIUM. H. P. Wolff and R. Fischer. p.92-4 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies of organ distribution and urinary and intestinal excretion of hafnium are summarized. The distribution pattern of hafnium complexes was also reviewed. (J.S.R.)

1397 SELENIUM. H. P. Wolff and R. Fischer. p.95-8 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the organ distribution and elimination of selenium are summarized. (J.S.R.)

1398 LEAD. H. P. Wolff and R. Fischer. p.99-102 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the resorption, excretion, and distribution of lead are summarized. (J.S.R.)

1399 ARSENIC. H. P. Wolff and R. Fischer. p.103-10 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Tracer studies on the distribution and excretion of arsenic in physiological and pathological situations are summarized. (J.S.R.)

1400 MOLYBDENUM. H. P. Wolff and R. Fischer. p.111-14 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The toxic properties of molybdenum are reviewed. Tracer studies on the metabolism, distribution, and transfer of molybdenum are summarized. (J.S.R.)

1401 MANGANESE. H. P. Wolff and R. Fischer. p.115-21 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The biological functions of manganese as a trace element are briefly reviewed. Tracer studies on the metabolism, distribution, and excretion are summarized. (J.S.R.)

1402 COBALT. Neubert Lang. p.122-32 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Physiological significance and pharmacological effects of cobalt are briefly reviewed. Tracer studies with cobalt which are summarized include uptake by organisms, transport in blood, organ distribution, excretion, tumor accumulation, cobalt in thyroid functions, and cobalt effects on the erythropoesis rate. The methodics of radiocobalt research are discussed. (J.S.R.)

1403 IRON METABOLISM. Walter Keiderling. p.133-78 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The study treats in the first part methodical questions with consideration of modern ferrokinetic investigation techniques. A discussion of the results obtained with these techniques is extended to the physiology and pathology of iron metabolism. (J.S.R.)

1404 ACTUAL PROBLEMS OF MUSCLE PHYSIOLOGY AND THEIR ANALYSIS WITH ISOTOPES. Albrecht Fleckenstein. p.179-228 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The electrophysiological and biological problems of cation exchange and the metabolism of phosphoric acid compounds in the skeleton and heart musculature are reviewed, and the results obtained in tracer studies are summarized. (J.S.R.)

1405 BIOCHEMICAL BASIS OF NERVE ACTIVITY. David Nachmansohn. p.229-51 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

A brief summary is given of the biochemistry of nerve activity. Topics discussed are the events during activity recorded by physical methods, essentiality of acetylcholinesterase in conduction, sequence of energy transformations, muscular forces in the problems of the acetylcholine system and their relation to function, the acetylcholine receptor, and the effects of lipid soluble quaternary ammonium ions. (J.S.R.)

1406 ISOTOPES IN STUDIES ON THE METABOLISM OF BONES AND TEETH. P. M. Johnston. p.252-8 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

The problems of study of bones and teeth fall into two basic divisions: the origin and composition of the matrix and the mineralization or calcification of the matrix. These two phases—the organic and the mineral—are treated separately. C^{14} and S^{35} were used to expand the knowledge of the constitutions of bone and tooth matrices. Ca^{45} and P^{32} were used to determine differences in mineralization of enamel, dentine, and bone. Radioisotopes have permitted a more precise delineation of the loci of initial mineralizations. Differences in the kind of bone growth were shown. The time sequence of matrix formation and its subsequent calcification were determined more exactly. (J.S.R.)

1407 USE OF RADIOACTIVE ISOTOPES IN STUDYING THE METABOLISM OF MITOCHONDRIA. Philip Siekevitz. p.259-67 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

A summary is given of those aspects of mitochondrial metabolism which are truly specific for mitochondria and for which isotopes have proved to be particularly useful tools. These categories include the turnover of mitochondrial components, the concentration and turnover of low-molecular-weight compounds and ions by mitochondria, and the synthesis and turnover of adenosine triphosphate by the mitochondria. (J.S.R.)

1408 METABOLISM OF MICROORGANISMS. L. Jaenicke. p.268-348 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

A comprehensive survey is made of isotopic studies on the metabolism of microorganisms. Topics discussed include microorganisms of biochemical reagents, classification of bacteria, selection and culture of bacteria, enzymatic investigation techniques with microorganisms, degradation and regeneration of cell substances, enzyme mechanisms, metabolism cycle in microorganisms, auxotrophic mutants, biosynthesis of complex molecules, microbiological methods for the defined degradation of cell constituents, and biosynthesis of labeled intermediary products with microorganisms. (J.S.R.)

1409 ISOTOPE STUDIES ON VIRUSES AND BACTERIOPHAGES. Gebhard Koch. p.349-66 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

A review of isotopic studies on viruses and bacteriophages is introduced by a brief description of the (T2H—E. coli H) system and of the results obtained with it in order to illustrate the application of tracer techniques to problems of virus multiplication. Topics discussed include the composition of phage T_2 and the isolation of different phage components, the properties of phage components, functions of protein and DNA during viral growth, mortality of phage caused by decay of incorporated P^{32}, metabolism of phage-infected bacteria, transfer of parental viral material to progeny, and isotope studies with animal viruses. (J.S.R.)

1410 ISOTOPES IN GENETIC INVESTIGATIONS. F. Kaudewitz. p.367-92 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

A survey is made of the utilization of isotopes in genetic studies on bacteriophages, bacteria, protozoa, lower plants, and higher plants and animals. (J.S.R.)

1411 RADIOACTIVE ISOTOPES IN IMMUNOLOGY. Paul H. Maurer. p.393-418 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

A survey is made of studies made from 1953 to July 1958 on the use of radioisotopes in immunology. The areas covered are procedures employed for radio-labeling antigens and antibodies, antigen-antibody reactions "in vitro," metabolism and fate of antigens and antibodies "in vivo" including soluble antigen-antibody complexes, "in vitro" research on antibody synthesis, and use of radioisotopes in such areas as "immunological unresponsiveness." (J.S.R.)

1412 BIOCHEMISTRY OF TUMORS. Hans Lettré. p.419-32 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

In a summary of tracer studies of the biochemistry of tumors, the properties of tumor cells, cancerogenic factors, and tumor-inhibiting factors are discussed. (J.S.R.)

1413 THE USE OF RADIOACTIVE ISOTOPES FOR PHARMACOLOGICAL RESEARCH. Daniel E. Duggan and Elwood O. Titus. p.433-48 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

As an introduction to a survey of literature on the use of isotopes for pharmacological research, the factors governing the design of isotopic experiments with drugs are discussed. The use of I^{131} in the study of drugs affecting thyroid function and the use of isotopes of C, P, N, and H in following the effects of antimetabolites upon nucleic acid metabolism are not included. Isotopic studies are divided into two categories: direct techniques designed to follow the fate of labeled drugs and indirect techniques to observe the effects of drugs upon the utilization or catabolism of labeled metabolic pools. (J.S.R.)

1414 PHOTOSYNTHESIS. James A. Bassham. p.449-78 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (UCRL-9412). (In English)

In the study of photosynthesis, the radioisotopes C^{14}, P^{32}, T, and S^{35} have been of primary importance. Techniques used in studies with these isotopes are described, but only key experiments using these techniques are outlined. The use of C^{14} is described in detail as the techniques used with it are applicable to the other isotopes. The preparation of plant material for photosynthetic studies is briefly reviewed as an introduction to the discussion of the individual isotopes. (J.S.R.)

1415 ISOTOPES IN STUDIES WITH ANTIMETABOLITES. S. B. Binkley. p.479-94 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

A combination of radioisotopes and antimetabolites has been used to gain information about biochemical reactions. A major portion of the present work was devoted to studies on the incorporation of chemical analogs into metabolic products and the biochemical consequences of these chemical changes. The study of virus host relations is also reviewed. Purine, pyrimidine, and amino acid analogs, carbohydrate metabolism, and permeases are the other topics discussed. (J.S.R.)

1416 CIRCULATORY DIAGNOSTICS WITH THE HELP OF RADIOACTIVE ISOTOPES. Peter G. Waser. p.495-550 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

In investigating circulatory problems with isotopes both dynamic and static methods are used, and the general methodics of such studies are reviewed. Studies made are summarized. Topics discussed include determination of blood volume, determination of circulation time, blood passage through extremities and organs, hemodynamic problems, cardiac insufficiency, and investigation on shock. (J.S.R.)

1417 TUMOR DIAGNOSTICS. J. H. Mueller. p.551-75 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

In the diagnosis of tumors with radioactive substances, there are two principal groups of substances. In the first group, the simple radioindicators, the radioisotope is used in pure form or as soluble inorganic compounds, generally in mixture with the corresponding inactive element. The second group comprises complex organic substances in which a suitable artificial radioactive isotope is incorporated through chemical synthesis. A summary of the study done with these two groups is presented. (J.S.R.)

1418 IODINE. THYROID DIAGNOSIS WITH RADIOIODINE. H. W. Bansi. p.576-659 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

A summary on the utilization of radioiodine for thyroid malfunction diagnosis and therapy is presented. In order to understand the properties of iodine which make it suitable for thyroid diagnosis, the physiology of iodine metabolism is first reviewed. Clinical studies of thyroid diseases with radioiodine are described. (J.S.R.)

1419 RADIO-VITAMIN B_{12} IN CLINICAL DIAGNOSIS. Hellmuth C. Heinrich. p.660-96 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

Radiometric vitamin B_{12} analysis is suitable for the study of the origin or genesis mechanism of B_{12} deficiency. A summary is given of diagnostic tests made to determine such deficiencies. The topics discussed are B_{12} resorption tests, diagnosis of B_{12} metabolism interferences in man, and maximum permissible activity of incorporated labeled B_{12}. (J.S.R.)

1420 THE REGULATION OF ERYTHROPOIESIS AS STUDIED WITH ISOTOPES: ERYTHROPOIETIN. Donald C. Van Dyke and John H. Lawrence. p.697-705 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

The constancy of red cell number and volume in the normal mammalian organism indicates that a regulatory mechanism must exist. The development of methods of assay for erythropoietic activity utilizing radioisotopes has greatly stimulated investigation into the possible sources of erythropoietins and the extent to which they are responsible for the normal regulation of erythropoiesis. Tracer studies of the regulation of erythropoiesis with erythropoietins are summarized. (J.S.R.)

1421 THE LOCALIZED APPLICATION OF ARTIFICIAL RADIOACTIVE ISOTOPES. J. Becker and K. E. Scheer. p.706-84 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The basic principle of radiation therapy is the localization of the radiation effect at a given foci of infection with the best possible protection to the surrounding tissues. In the present survey, irradiation methods are arranged according to the type of application and not by elements. The topics discussed are surface irradiation, interstitial irradiation, intracavity irradiation, remote irradiation, and dose measurement and calculation. (J.S.R.)

1422 INTERNAL TUMOR THERAPY WITH ARTIFICIAL RADIOACTIVE ISOTOPES (EXCLUSIVE OF BLOOD DISEASES AND THYROID). J. H. Mueller. p.785-827 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The physical and chemical aspects of internal, selective irradiation with artificial radioisotopes are briefly reviewed as an introduction to a survey of tumor therapy with isotopes. A selective irradiation can be realized by three methods: metabolic, chemical micromechanical, and engineering mechanical. The first two methods are comprehensively reviewed. (J.S.R.)

1423 HYPOPHYSECTOMY WITH NUCLEAR RADIATIONS. James L. Born, John H. Lawrence, Cornelius Tobias, Richard Carlson, Franco Sangalli, and Graeme Welch. p.828-32 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In English)

High energy proton and alpha particles from the 184-inch synchrocyclotron at the Lawrence Radiation Laboratory of the University of California were used for pituitary irradiation in 100 patients with metastatic mammary carcinoma and in various pituitary and hormonally dependent diseases. Peak doses of 14000 to 30000 rad were delivered to the center of the pituitary. At the higher hypophysectomizing dose level decreased pituitary function and marked gross and microscopic damage to the pituitary were demonstrated. Decrease in pituitary function and the consequent effects on the target end-organs were manifested in depression of the thyroid I^{131} uptake and decrease in 24-hour pituitary gonadotropins, urinary steroids, and estrogen excretion. These correlated well with clinical evidence of hypopituitarism. Objective evidence of improvement was obtained in some patients with mammary carcinoma and acremegaly. The effect of pituitary irradiation on a series of patients with diabetes mellitus is now being studied. (auth)

1424 BLOOD DISEASES. L. Heilmeyer and W. Keiderling. p.833-85 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The only radioisotopes in general use for the therapy of blood diseases are P^{32} and Au^{198}. The physical properties of these isotopes, their physiological behavior in organisms, and the dosimetric principles for beta and gamma emitters are therefore briefly summarized. The radiotherapy of polycythaemia vera, leukoses, and hemoblastoses of the reticuloendothelial system are reviewed. The disadvantages of isotope therapy are indicated. (J.S.R.)

1425 RADIOIODINE IN DIAGNOSIS AND THERAPY OF THYROID NEOPLASMS. Wolfgang Horst. p.886-950 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

First, I^{131} diagnosis with isopulse image or scintigram and I^{131} function diagnosis are discussed. The classical treatment of thyroid carcinomas and the place of modern radiation therapy are reviewed. Then iodine therapy of thyroid neoplasms is discussed in detail. (J.S.R.)

1426 THE TREATMENT OF HYPERTHYROTOXICOSIS WITH RADIOIODINE. Heinz Oeser, Hans Billion, and Paul Kuehne. p.951-78 of "Radioactive Isotopes in Physiology, Diagnostics, and Therapy. Volume II." Berlin, Springer-Verlag, 1961. (In German)

The aim of radioiodine treatment of hyperthyroidism is the conversion of the diseased increased thyroid function into a normal function state, if possible with simultaneous reduction of the struma to normal by "radiation resection." In a review of this therapy, the physical properties of radioiodine, radiobiological effect of radioiodine, selection and contraindications, techniques of radioiodine application, results of radioiodine therapy, and critical evaluation of the method are discussed. (J.S.R.)

Biochemistry, Nutrition, and Toxicology

1427 (NP-10945) WORKSHOP ON BERYLLIUM, JANUARY 5 AND 6, 1961. (Cincinnati, Univ. Kettering Lab.). Contract AF33(600)-37211. 114p.

Proceedings of a workshop on Be are presented which were designed to bring together as many as possible of the persons who have had experience in the diagnosis, treatment, and prevention of berylliosis. Seventeen formal presentations made by invited guests whose observations and data were gathered over a period of years are included. Conclusions of committees on clinical and diagnostic considerations, analytical and environmental considerations, and epidemiological considerations are also included. (J.R.D.)

1428 (ORNL-3189(p.197-210)) STABLE ELEMENT METABOLISM BY MAN. S. R. Koirtyohann and C. Feldman (Oak Ridge National Lab., Tenn.).

The techniques in the spectrographic determination of trace elements in human tissue performed by the ORNL Analytical Chemistry Division including the methods of sample preparation, the problem of cross-contamination of samples, instrumentation involved, standards preparation, exposure conditions, precision and sensitivity of the method, and the photographic exposure work are discussed. The trace element concentrations of ~17 elements in brain, diaphragm, and heart of 28 cadavers from San Francisco are presented. The median, 10th, and 90th percentiles for the trace metal concentrations in organs and tissues of U. S. adults (>20 years of age) were determined. Studies of the age trend of trace metal concentrations in liver, lung, and kidney were carried out. Also, a nonparametric statistical method was applied to the measurements of Cu, Al, and Zn concentrations in human kidneys to estimate the maximum per cent of the population which exceeds the mean sample concentration by a factor of three. At the 95% confidence level, this study indicated that not more than 9% of the adult urban population exceeds three times the sample mean. The effect of the size of sample on this estimate is discussed. (auth)

1429 (ORNL-3189(p.210-21)) MICROSCOPIC AND AUTORADIOGRAPHIC STUDIES OF URANIUM DISTRIBUTION IN RAT KIDNEY. E. S. Jones and S. R. Bernard (Oak Ridge National Lab., Tenn.).

Studies of the distribution of uranium in rat kidney at the microscopic level were carried out to obtain more information relating to the phenomenon of prolonged retention of uranium by kidneys of animals given an intravenous administration of a large mass of uranium. The distribution of uranium in the cortex of rat kidney was determined at different times after injection and for different injected amounts of uranium. Log-normal distribution curves could not always be fitted to the data. Data obtained in studies of leaching of uranium from kidney tissue into the formalin fixative and the dehydrating solutions indicated that very little uranium was leached. Distribution curves determined from measurements made on autoradiographs of kidney tissues prepared with the freeze-dry method were similar to the curves determined from data derived from formalin-fixed and dehydrated tissue. The diameters of tubules from kidneys of uranium-injected rats did not differ significantly from those of the controls or correlate with the amount of uranium injected. The diameters of the glomeruli, however, decreased with increasing levels of uranium injection. More data on the nonuniform distribution factor are presented. These data indicate that the cortex contains ~1.4 times the average amount in the kidneys. (auth)

1430 (ORNL-3189(p.224-7)) THE EXCRETION PATTERN OF Sr^{90} AND Ca^{45} IN MAN. L. B. Farabee (Oak Ridge National Lab., Tenn.).

Urinary and fecal excretion rates of Sr^{90} and Ca^{45} were determined for an employee who sustained a percutaneous exposure. The rate function of Sr^{90} excretion in the urine was seen to be very similar to that of two experimental subjects receiving single intravenous injections of Sr^{85}. On the third day after exposure, the employee increased his calcium intake to above 4 g/day (via milk), and this action resulted in doubling the stable calcium and also the Ca^{45} urinary excretion rates. There was no significant change observed in the Sr^{90} excretion rate. For the first 22 days, 61% of the total Ca^{45} excretion was in the urine, while at 60 days about 90% of the total excreted Sr^{90} had been eliminated via the urine. (auth)

1431 (ORO-469) RESEARCH IN MOLD METABOLISM. Final Scientific Report. Jackson W. Foster (Texas. Univ., Austin). Aug. 10, 1961. Contract AT-(40-1)-1040. 6p.

Techniques were devised for the isolation and cultivation of and experimentation with, microörganisms utilizing various individual hydrocarbons as sources of carbon and energy. The hydrocarbon specificities of some 30 different pure hydrocarbons were determined. A survey of stock cultures of bacteria and fungi isolated on conventional media proved capable of using one or more hydrocarbons as sole sources of carbon and energy. The physiology and metabolism of *Pseudomonas methanica* was studied extensively. It was concluded that the primary attack on the hydrocarbon molecule takes place by a mechanism which adds one atom of oxygen to a terminal methyl group. A study of hydrocarbon utilization by species of Mycobacterium revealed that these bacteria have a conspicuous affinity for growing at the expense of a variety of methyl ketones. Several Mycobacteria were found to be able to oxidize hydrogen. Several bacteria were found to oxidize long-chain alkanes. The growth of various microörganisms on hydrocarbons was accompanied by the synthesis of B vitamins and amino acids. The organic acid metabolism of certain filamentous fungi was also studied. (M.C.G.)

1432 (TID-13509) RADIOACTIVE ZINC-65 IN MARINE ORGANISMS IN FISHERS ISLAND SOUND AND ITS ESTUARIES. Progress Report. Donald M. Skauen (Connecticut. Univ., Storrs). [1961]. Contract AT(30-1)-2487. 31p.

The determination of Zn and Zn^{65} in shellfish in Fishers Island Sound and its estuaries is described. Considerable variation was found in the zinc content of oysters from 3 areas in the Thames River. The zinc in moist-tissue of oysters from these areas ranged from 0.135 to 0.280%. The Zn^{65} content of the oysters compared favorably with those found in other areas. The effects of the anion associated with Zn^{65} on its rate and extent of uptake by oysters were investigated. The chloride, sulfate, phosphate, and tartrate anions all demonstrated the same effect on the rate and extent of uptake. When the zinc ions were chemically complexed, a significant difference in the rate and extent of uptake was observed. It was determined that an excess of Zn^{65} must be used in order to achieve maximum uptake by the tissue because of extremely large amounts of material which are absorbed onto the shells of the oysters. (M.C.G.)

1433 (TID-14099) ATOMIC ENERGY COMMISSION [PROGRESS REPORT ON BONE RESEARCH], 1960-1961. (Presbyterian-St. Luke's Hospital, Chicago). Contract [AT(11-1)-507]. 88p.

A review of osteoporosis concepts is presented. Activities in an experimental program to study osteoporosis by examining mineral metabolism in bone and by examining bone composition and density are reported. Sr^{85} was administered to seven osteoporotic patients as a tracer for skeletal mineral metabolism. The activity levels in the blood and the excretion rate were measured. From these data the accretion rate and the diffusible component volume were calculated. It was found that the accretion rate was not increased in any case. The size of the diffusible component was normal in six patients and reduced in one. Concurrent experiments with estrogen administration were conducted. Over-all results indicate that in osteoporosis, the rate of bone accretion is never elevated and an effect of estrogen administration was the decrease of bone resorption rather than stimulation of bone formation. In studies of skeletal metabolism, the kinetics of Sr^{85} metabolism was compared in normal subjects and patients with skeletal disorders. Various aspects of the results are analyzed and it is concluded that values obtained by kinetic studies appear to be quantitative, reproducible, and to correlate with presently established information on alterations of bone metabolism in systemic deseases. In studies of peripheral circulation and bone growth, I^{131}-tagged human serum albumin was injected in animals. The investigation was conducted to determine blood volume turnover rate in extremities, to correlate changes in this rate with fractures and bone disorders, and to examine the method for use in evaluation of circulation under certain pathological conditions. Data and findings are included. Data are also included on *in vitro* mobilization of Sr^{85} during bone formation and bone density studies. (J.R.D.)

1434 (TID-14232) THE BIOSYNTHESIS OF FATTY ACIDS IN FLAX EMBRYOS, *LINUM USITATISSIMUM* L. (thesis). Leslie F. Smith (Arizona. Univ., Tucson). 1961. Contract [AT(11-1)-262]. 111p.

Biotin is an important factor in the biosynthesis of fatty acids in developing flax embryos. The biotin content of flax embryos increases rapidly at a particular physiological age during maturation. Just prior to this physiological age, fat synthesis is stimulated by addition of biotin to embryos cultured *in vitro.* In agreement with previous work, light and biotin were required for optimal incorporation of radioacetate into fatty acids in developing flax embryos cultured *in vitro.* All wavelengths of visible light stimulated the synthesis of stearic, oleic, linoleic, and linolenic acids. Far-red light (approximately 7350 Å) completely inhibited synthesis of the polyunsaturated fatty acids, but had no effect on the synthesis of stearic and oleic acids. Young embryos synthesized mainly stearic and oleic acids but old embryos synthesized these acids and linoleic and linolenic acids in addition. In embryos cultured in vitro, stearic and oleic acids were synthesized early in the culture period and linoleic and linolenic acids were synthesized later. There is evidence that long-chain fatty acids are synthesized in flax embryos by two metabolic pathways. Stearic and oleic acids are synthesized by one pathway and linoleic and linolenic acids are synthesized by another pathway. Biotin appears to be involved in the synthesis of early precursors, possible short-chain intermediates, in both metabolic pathways. There are both dark and light reactions in the synthesis of polyunsaturated fatty acids, and the light reaction is dependent on an aerobic culture condition. A metabolic map summarizing these findings is presented. (auth)

1435 (TID-14233) THE SYNTHESIS OF FATTY ACIDS IN A HIGHER PLANT. Final Report, July 1, 1953 to April 30, 1961. Edwin B. Kurtz, Jr. (Arizona. Agricultural Experiment Station, Tucson). Nov. 10, 1961. Contract AT(11-1)-262. 11p.

Results are presented of investigations on synthesis of fatty acids in flax fruits and embryos, with a few experiments on flax stems and cotton and cactus seeds. Acetate and malonic acid were found to be precursors of fatty acids, and acetate is condensed "head-to-tail" to form fatty acids. The roles of biotin and light in fatty acid synthesis were elucidated. There are two pathways for fatty acid synthesis in the flax embryo, stearic and oleic acids being formed in one pathway and linoleic and linolenic acids in the other. In aerobic cultures, stearic and oleic acids are first formed, then linoleic and linolenic acids begin to form, while under anaerobic conditions in the light, little or no linoleic or linolenic acid is formed. (D.L.C.)

1436 STUDIES IN VASCULARISATION OF HEALING WOUNDS WITH RADIOACTIVE ISOTOPES. Arne Weiber. Acta Chir. Scand., Suppl. No. 237, 1-72(1959). (In English)

A series of five experiments were made. In the first experiment, a paramedian transrectal incision was made in rabbits, dogs, and guinea pigs, and the wound was afterwards closed by a special suture technique so that the wound surfaces remained perpendicular to the surface of the skin. On the uneven days after the operation, 0.02 ml of crystalloid isotope solution (I^{131}) was deposited in the wound. In a smaller series of rabbits, in which Na^{24} was used instead of I^{131}, results were about the same. A similar experiment was performed in the calves of rabbits, and I^{131} was used. In the third experiment rabbits were treated the same as in the second experiment with the exception that radioactive iodinated human serum albumin was used instead of I^{131}. In the fourth experiment, rabbits received 30 ml of blood with Cr^{51} labeled erythrocytes instead of I^{131}. In the fifth experiment P^{32} was used. Observations of all the experiments suggest that vascularization of the healing wound progresses successively during the first 5 days and then gradually decreases, but is still about 50% higher than in intact tissue as late as the 13th day. 135 references are included. (P.C.H.)

1437 INCIDENCE OF HYPOTHYROIDISM AND RECURRENCES FOLLOWING I^{131} TREATMENT OF HYPERTHYROIDISM. Ulla Beling and Jerzy Einhorn (Karolinska Sjukhuset, Stockholm). Acta Radiol., 56: 275-88(Oct. 1961). (In English)

The incidences of hypothyroidism and its recurrence were studied in 791 patients at varying intervals after I^{131} treatment of hyperthyroidism. Radiotherapy with I^{131} tends to lead to hypothyroidism, both early and, especially, late. After a long remission, however, there is small likelihood of recurrence of hyperthyroidism. The influence of sex, age, type of goiter, and number of I^{131} therapy doses administered on the incidence of hypothyroidism was studied. (auth)

1438 RECTAL DOSE AND RECTAL DAMAGE IN THE INTRACAVITARY TREATMENT OF UTERINE CANCER. Paul Strickland and C. Gregory (Mount Vernon Hospital and the Radium Institute, Northwood, Eng.). Acta Radiol., 56: 289-95(Oct. 1961). (In English)

A method of measuring dose rate on the anterior rectal wall of patients undergoing intracavitary treatment for uterine cancer is described. A scintillation probe with a sodium iodide crystal with suitable instrumentation, allowing the direct reading of the gamma dose rate, is employed. No positive correlation between high dose and rectal reaction was observed in measurements of 169 cases. (auth)

1439 DESIGN OF A RADON EXPOSURE SYSTEM. Robert H. Wilson (Univ. of Rochester, Atomic Energy Project, Rochester). Am. Ind. Hyg. Assoc. J., 22: 409-15(Oct. 1961).

A laboratory facility for the exposure of animals (mice) to known concentrations of radon in an inhalation toxicity chamber is described in some detail. A dynamic system is used providing for intermittent or long-term exposures. De-emanation of a radium chloride solution by aeration is used as the source. Exposures to radon provides diffuse irradiation of the respiratory tract by an alpha-emitter as contrasted to discrete particulate sources. (auth)

1440 VIRTUAL ABSENCE OF TURNOVER IN CADMIUM METABOLISM: Cd^{109} STUDIES IN THE MOUSE. G. C. Cotzias, D. C. Borg, and B. Selleck (Brookhaven National Lab., Upton, N. Y.). Am. J. Physiol., 201: 927-30(Nov. 1961). (BNL-5471)

Following injection, radioisotopes of physiologically occurring elements are excreted at rates that increase upon metabolic loading with stable carrier. In contrast, Cd^{109} showed negligible total-body turnover in the mouse regardless of challenges with Cd or Zn, and alimentary absorption occurred irrespective of the body's Cd burden. As opposed to certain bone-seeking nonphysiological radioisotopes which also show this behavior, Cd^{109} concentrated primarily in nonosseous soft tissue. Intracellularly the distribution of Cd^{109} resembled that of Zn^{65}, except for a lower uptake of Cd^{109} by the nuclear fraction. Other dissimilarities between Cd and Zn metabolism included the presence of a well-defined excretory pathway only for Zn and different effects of Cd and Zn carriers upon the organ distribution of Cd^{109}. These findings suggest that Cd does not obey homeostatic control. Similarities between Cd and Zn metabolism imply that Cd may function, in part, as an antimetabolite of Zn, and that significant physiological discrimination between Cd and Zn exists, at least at the level of excretory processes. (auth)

1441 CYCLIC EVENTS IN THE VIRAL CYCLE. I. EFFECTS OF TEMPERATURE. André Lwoff and Marguerite Lwoff (Institut Pasteur, [Paris]). Ann. inst. Pasteur, 101: 469-77(Oct. 1961). (In French)

Infra-optimal temperatures block a step in the primary phase of the viral cycle and allow the completion of the secondary phase. Supra-optimal temperatures block a step in the secondary phase of viral development and allow the completion of the primary phase. The sensitivity of viral development to temperature (SDT) is expressed by rt, which corresponds to the supra-optimal temperature at which the yield is decreased by a factor 90%. The rt, hence the SDT, can be modified by viral mutations. One mutational event shifts the totality of the curve expressing the SDT. It affects at the same time the psychrosensitivity and the thermosensitivity in opposite directions: one increases when the other decreases and vice versa. One mutation apparently affects one viral molecule which takes part in both the primary and the secondary phase of the viral cycle. A reversible reaction affecting this molecule takes place in opposite directions during the primary and the secondary phase of the viral cycle. (auth)

1442 CYCLIC EFFECTS IN THE VIRAL CYCLE. II. EFFECTS OF HEAVY WATER. André Lwoff and Marguerite Lwoff (Institut Pasteur, [Paris]). Ann. inst. Pasteur, 101: 478-89(Oct. 1961). (In French)

D_2O increases the viral yield at supra-optimal temperatures and decreases it at infra-optimal ones. The effect in one or the other direction is all the more marked that the concentration of D_2O is higher. D_2O increases the duration of the primary phase. This increase is all the more important that the temperature is lower and that the rt of the strain is higher. For a given supra-optimal temperature, the effect of D_2O is all the more higher that the rt of the strain is lower. For a given infra-optimal temperature, the effect of D_2O is all the more marked that the rt of the strain is higher. D_2O as an agent increasing the effects of infra-optimal temperatures acts on a primary phase of the viral cycle. Once the primary phase is completed, D_2O does not affect the rate of viral development. D_2O as an agent decreasing the effect of supra-optimal temperatures acts on the secondary phase of the viral cycle. The preincubation of cells in the presence of D_2O does not modify the viral development as a function of the temperature. A development of three hours in the presence of D_2O is without effect on the subsequent viral development in the absence of D_2O. Virions developed at supra-optimal temperature in the presence of D_2O do not show a modified genotype. (auth)

1443 CYCLIC EVENTS IN THE VIRAL CYCLE. III. DISCUSSION. André Lwoff and Marguerite Lwoff (Institut Pasteur, [Paris]). Ann. inst. Pasteur, 101: 490-504(Oct. 1961). (In French)

A single mutational event affects at the same time in opposite directions the sensitivity of viral development to temperature (SDT). As a result of a mutation affecting the SDT, the thermosensitivity increases whereas the psychrosensitivity decreases or vice versa. Infra-optimal temperatures interfere with an event of the primary phase of the cycle, whereas supra-optimal temperatures interfere with an event of the secondary phase. Heavy water increases the effects of infra-optimal temperatures on the evolution of the primary phase and decreases the effects of supra-optimal temperatures on the evolution of the secondary phase. The hypothesis is put forward that supra- and infra-optimal temperatures displace in one direction or the other the equilibrium of a reaction affecting the structure of a viral macromolecule. One of the states only would be compatible with the evolution of the primary phase, the other with the evolution of the secondary phase. Temperature would affect the equilibrium of the reaction, whereas heavy water would displace the transition temperature. The zone of optimal development would correspond to the transition temperature. Hydrogen bonds play an important role in the postulated structural change which could, as already said, affect a viral macromolecule, protein or nucleic acid, and correspond to the transition from a structure of a given order to a structure of higher order or vice versa. Various aspects of viral cycle are discussed in the light of experimental data and theoretical interpretations. Considered at the molecular level, a viral cycle implies necessarily at least one cyclic reversible event which has to take place in opposite directions during the primary and the secondary phases. The conditions prevailing in the infected cell should favour alternately one and the other structure, that is, one or the other phase. (auth)

1444 EFFECT OF DIFFERENT EXTERNAL LABELS ON THE METABOLISM OF DOUBLY LABELED HETEROLOGOUS PROTEINS. Harry Walter, Sidney Fleischer, and Felix Haurowitz (Indiana Univ., Bloomington). Arch. Biochem. Biophys., 95: 290-5(Nov. 1961).

Rats and rabbits were injected with heterologous proteins doubly labeled with S^{35} amino acids and either diazotized anthranilic acid-C^{14} or I^{131}. The elimination rate of the isotopes from the plasma proteins and their incorporation into the tissue proteins was measured. Analyses revealed that the elimination rate of the injected proteins from the circulation is higher for proteins heavily substituted by the external labels (I^{131} or azobenzoate-C^{14}) than for the lightly substituted proteins; that a large portion of the S^{35} amino acids is reutilized for the formation of tissue proteins, and that the amount of I^{131} bound to the tissue proteins is negligibly small whereas the fraction of protein-bound C^{14}, 9 days after injection, varies from about 8 to 70% of the fraction of protein-bound S^{35} amino acids. The protein-bound C^{14} is not present in the form of amino acids but as a derivative of anthranilic acid. Reasons for the different metabolic behavior of the two external labels, I^{131} and o-azobenzoate-C^{14}, are discussed. (auth)

1445 COMPARATIVE STUDIES OF THE DECORPORATION EFFECTIVENESS OF A NEW CHELATING AGENT. A. Catsch and D. Schindewolf-Jordan (Kernforschungszentrum, Karlsruhe, Ger.). Experientia, 17: 205-6(1961). (KFK-58). (In German)

The influence of several new polyaminopolycarboxylic acids on the distribution of carrier-free radiocerium in the organs of the rat was studied. Some theoretical and practical implications of the experimental findings are discussed. (auth)

1446 NOTES ON THE PROBLEM OF THE TRANSPLANTATION OF BONE MARROW IN DOGS. A. Puza, M. Klvaňa, E. Kunštadt, and M. Zaduban (Šafárik Univ., Košice, Czechoslovakia). Folia Biol. (Prague), 7: 343-8 (1961). (In English)

Results are presented from an experimental study prompted by previous unsatisfactory results with the transplantation of bone marrow in higher mammals. The experiments were carried out in 15 dogs (eight experimental animals and seven controls). Five dogs exposed to fractionated whole-body supralethal γ irradiation with a dose of 900 to 1,200 r, were treated by transfusion of a bone marrow suspension from genetically distant donors, in amounts of $0.78 - 8.1 \times 10^9$ cells. All the experimental animals died, on an average, 11 days after irradiation. The control dogs, to which bone marrow was not administered, died somewhat sooner. In both groups the course of the post-irradiation period presented a picture of acute radiation sickness. Three dogs exposed to a single whole-body dose of Co^{60} received autologous bone marrow. This was therapeutically effective and the animals are still alive five months later. Their general clinical condition and the laboratory findings are again normal. The two controls died within 18 days after irradiation. (auth)

1447 THE RENAL EXCRETION OF STRONTIUM AND CALCIUM IN DOGS. R. J. Della Rosa, F. A. Smith, and J. N. Stannard (Univ. of Rochester, N. Y.). Intern. J. Radiation Biol., 3: 557-78(Nov. 1961). (In English)

Renal excretion and plasma clearance rates of Sr^{85} and Ca^{45} were determined in trained female dogs 18 to 24 hours after the simultaneous intravenous or subcutaneous administration of these two isotopes. Tubular reabsorption of Ca^{45} in the normal dog was nearly complete, being more than 99% of that filtered at the glomeruli. The reabsorption of Sr^{85} was consistently less than that of calcium, averaging less than 98%. Clearance measurements, using endogenous creatinine for determining the glomerular filtration rate, indicated a more rapid clearance from the plasma of the strontium isotope (0.91 ml/min for Sr^{85} and 0.17 ml/min for Ca^{45}). As a result of these differences, the excretion of Sr^{85} was 5 to 6 times more rapid than that of Ca^{45}. Drastic changes in plasma-calcium levels, as achieved by thyropara-thyroidectomy and parathyroid-extract injection, did not appreciably alter the ratio of the excretion rates despite marked changes in the absolute values. The infusion of sodium citrate caused large increases in the urinary excretion of both strontium and calcium and countered the renal discrimination process. The excretion of both ions was also significantly increased during alkalosis brought about by the infusion of sodium bicarbonate. Acidosis was without effect. (auth)

1448 THE EFFECT OF METABOLISM ON THE TRANSPORT OF ^{15}O-LABELLED OXYGEN THROUGH *VICIA FABA* ROOTS. N. T. S. Evans and M. Ebert (Hammersmith Hospital, London). Intern. J. Radiation Biol., 3: 627-36(Nov. 1961). (In English)

The transport of oxygen through continuous gas spaces in the root of the seedling of *Vicia faba* was investigated, using coincidence-counting of labelled nitrogen—oxygen gas mixtures containing 19% and 0.4% oxygen. The observations indicate that, in diffusing to the elongating zone and the radiosensitive root meristem, a little oxygen is lost to the tissue. This loss occurs in the region of the cotyledon and hypocotyl. (auth)

1449 COMPARISON OF THE PLASMA CONCENTRATION AND URINARY EXCRETION OF STRONTIUM AND CALCIUM IN MAN. D. W. H. Barnes, Margaret Bishop, G. E. Harrison, and Alice Sutton (Medical Research Council, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 3: 637-46(Nov. 1961). (In English)

The relatively short-lived, radioactive isotope of strontium, strontium-87m ($T^1\!/_2$ = 2.7 hours) was used to measure plasma concentration and urinary excretion in man, up to six hours after a dose of 5 μc. The radiation dose to the tissues was quite small, so that successive experiments were made on a given subject. The isotope was taken by mouth in several ways: after a fasting period, between meals, with a meal, and in some experiments after a daily ingestion of 10 mg of stable strontium. The plasma concentration and urinary excretion of calcium were also measured, so that the renal discrimination between strontium and calcium could be derived. The renal clearance of strontium varied only some 20% for a given subject, despite the changes in the experimental conditions, but varied from 5.3 to 10.8 liters/day from individual to individual. The renal discrimination between strontium and calcium was more constant, however, ranging from 2.8 to 4.3, the mean value being 3.5. (auth)

1450 MATHEMATICAL ANALYSIS OF METABOLISM USING AN ANALOGUE COMPUTER: I. ISOTOPE KINETICS OF IODINE METABOLISM IN THE THYROID GLAND. Nobuo Fukuda (National Inst. of Radiological Sciences, Tokyo) and Motoyosi Sugita. J. Theoret. Biol., 1: 440-59 (Oct. 1961).

Applications of analog computation and the phenomenological approach to isotope kinetics are discussed. A flow chart of iodine metabolism in the thyroid gland is presented, surmising that I$_2$ is incorporated into globulin in epithelial cells. A set of fundamental simultaneous equations of 17 independent variables describing the dynamical behavior of I^{131} in the thyroid gland is presented. Most system parameters are estimated from steady state considerations and significant relations between them are derived. The sets of equations are solved by analog computation. By varying the values of the system parameters, variations in the model system were obtained which suggested resemblance to pathological states in man. (auth)

1451 THE SIGNIFICANCE OF FACTORS UNDERLYING ACCUMULATION AND ELIMINATION OF I^{131} IN THE RADIOTHERAPY OF THYROTOXICOSES. Yu. E. Livergant and E. D. Chebotareva (Khar'kov Inst. of Medical Radiology). Med. Radiol., 6: No. 10, 11-16(Oct. 1961). (In Russian)

Discussion is given to clarify the conditions determining the sensitivity of the thyrotoxic patients to the radioiodine therapy. The proportion of the curative radioiodine dose absorbed by a thyreotoxic struma and the duration of its stay in the organism, which was equal to the effective period of its half life was investigated. Radiometric data were compared with clinical indexes. Examinations covering 65 patients suffering from thyrotoxicosis and undergoing radiotherapy revealed that optimal therapeutic effect involves higher I^{131} concentration in the thyroid and its more prolonged retention therein. These factors determining a true curative dose are to be taken account of in the course of treatment and for its prognosis. (auth)

1452 RADIATION AND COMBINED TREATMENT OF OSTEOGENIC SARCOMA CASES. G. G. Mitrov (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Health, RSFSR). Med. Radiol., 6: No. 10, 16-22(Oct. 1961). (In Russian)

A combined method of treatment was employed in the instance of 109 cases with malignant tumors of the bones belonging to the osteogenic group. The overwhelming majority of patients showed an appreciable clinical improvement, manifested in complete cessation of the pain, reduced size of the tumor, and better functioning of the extremities. Optimal effect was obtained following an intensive therapy in association with surgical interference. For patients treated with the radiation method alone, the life expectancy after the therapy depends, above all, on the amount of the dose. (auth)

1453 THE LOCALISATION OF BRAIN TUMOURS BY MEANS OF RADIO-ISOTOPES. [PART] II. F. Mundinger (Neurosurgical Univ. Clinic, Freiburg i. B.). Medicamundi, 7: 81-91(1961). (In English)

Methods of external localization for which gamma emitters find application are treated. Because of the penetrating power of this radiation, it can be recorded externally. The skull can be scanned by means of properly screened scintillation counters, thus making localization possible. The recording apparatus and the methods used to keep interference effects as small as possible are described, and the nuclides as well as their chemical compounds used in this technique are treated. (auth)

1454 PROLONGED BIOLOGICAL HALF-LIFE OF SODIUM-22 IN PATIENTS WITH ESSENTIAL HYPERTENSION. Lewis K. Dahl, Malcolm G. Smilay, Lawrence Silver, and Sanford C. Spraragen (Brookhaven National Lab., Upton, N. Y.). Nature, 192: 267-8(Oct. 21, 1961). (BNL-5525)

The sodium metabolism of patients with and without hypertension was studied using sodium-22 (physical half life, 2.6 years). Fifteen adult patients were studied. Seven patients had essential hypertension whereas the other 8 had unrelated diseases with normal blood pressure. The investigations were carried out while the patients were in a metabolic ward and were consuming a constant diet which contained about 250 mgm of sodium chloride by analysis. After the dietary regimen was established, sodium-22 (usually 2 to 4 μc) was given orally and the total body burden of the isotope was recorded every 1 to 3 days. Thereafter the patients daily intake of salt was increased by 2, 5, or 10 gm, at which level it remained for 2 to 4 weeks. The addition of the salt resulted in a prompt increase in the rate at which sodium-22 was lost from the body, manifested by a decrease in total body counts. At each of the three levels of salt ingestion, the hypertensive individuals, without exception, lost sodium-22 significantly more slowly than did those without hypertension ($P < 0.01$). The evidence shows that individuals with essential hypertension have a prolonged biological half life for sodium-22. Preliminary calculations suggest that this is the result of hypertensive patients having a large metabolic pool of sodium. (P.C.H.)

1455 ACTIVITY OF DEOXYRIBONUCLEASE AS RELATED TO ROOT-GROWTH. R. Goutier and M. Goutier-Pirotte (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Nature, 192: 371-2(Oct. 28, 1961).

Pea seeds were allowed to germinate on paper soaked with distilled water for 3 days at room temperature. Roots of approximately equal length were then selected and cut in two fragments: the tip, and a fragment immediately above the tip. It was found that the specific activity of acid DNase is much higher in the tip than in the other part of the root; the shorter the tip fragment, the higher the specific activity. Neutral DNase is also higher in the tip, but the difference between the two fragments is less marked than for the acid enzyme. Thus, the acid DNase seems linked to the process of growth in pea roots. (P.C.H.)

1456 ENTEROHEPATIC CIRCULATION OF BILIRUBIN. Roger Lester, J. Donald Ostrow, and Rudi Schmid (Thorndike Memorial Lab., Boston; Boston City Hospital; and Harvard Medical School, Boston). Nature, 192: 372 (Oct. 28, 1961).

After intraduodenal administration of both unconjugated and conjugated carbon-14 labeled bilirubin, much of the demonstrable absorbed radioactivity appeared in the bile as conjugated labeled bilirubin. The initial phase of absorption was more rapid for unconjugated bilirubin than for conjugated and the total absorption of the former appeared somewhat greater. Little radioactivity was recovered in the urine. In all instances, however, significant intestinal absorption and biliary excretion of the carbon-14 label were evident. (P.C.H.)

1457 THE INHIBITION OF THE RADIOCHEMICAL ALBUMIN SYNTHESIS BY RADIATION PROTECTION MATERIALS. Kurt Flemming (Universität, Greifswald, Ger.). Naturwissenschaften, 48: 555-6(1961). (In German)

Albumin synthesis, induced by x or UV radiation, is strongly inhibited by the presence of cystein and ascorbic acid. The protective substances were added to the solutions immediately before irradiation. The effectiveness of other compounds was also tested, and it was found that nonreducing aliphatic compounds are weakly effective, reducing aliphatic compounds are strongly effective, and nonreducing aromatic compounds are very strongly effective. The mechanism responsible for the inhibition of the radiation and photochemical albumin synthesis is discussed. (J.S.R.)

1458 EFFLUX AND RETENTION OF FOLIAR APPLIED PHOSPHORUS-32 AND SULFUR-35 BY INTACT BEAN ROOTS, AND THE INFLUENCE OF VARIOUS AMBIENT IONS ON THIS RELATIONSHIP. Fred H. Emmert (Univ. of Connecticut, Storrs). Plant and Soil, 14: No. 1, 33-42(Mar. 1961).

Tests were conducted to learn more about the quantitative aspects of efflux from intact plant roots and of possible influences of ion species in the recipient solutions on the process. Tests involved foliar introduction of P^{32} and S^{35} to bean plants and measurement of loss of isotope from roots to various single salt solutions. Comparisons were made of fraction lost as opposed to the fraction retained by the root. Both P^{32} and S^{35} were found to pass from bean root to surrounding solutions under all experimental conditions, however, less than 1% of what was in the root was lost. The process of exit of isotopes from roots was conditioned by composition of the surrounding medium. Data are tabulated. (C.H.)

1459 STRONTIUM-90 ABSORPTION BY DECIDUOUS TEETH. Analysis of Teeth Provides a Practicable Method of Monitoring Strontium-90 Uptake by Human Populations. Louise Zibold Reiss. Science, 134: 1669-73(Nov. 24, 1961).

Results of analyses of 20,439 teeth collected from children in the St. Louis area during 1959 and 1960 indicate that analysis of deciduous teeth provides accurate information concerning Sr^{90} deposition in bone. Teeth and bones developing in the same biologic environment were found to accumulate Sr^{90} and Ca in the same ratio. It was shown that collection of teeth can be accomplished on a large scale. (C.H.)

1460 RADIATION GRAFTING OF POLYMERS ON BIOLOGICAL OBJECTS. Yu. P. Kozlov and B. N. Tarusov. Vysokomolekulyarnye Soyedineniay, 3: 1265-76(Aug. 1961).

The study was conducted with winter wheat (Triticum vulgare) seeds and vinylpyrrolidone (VP). It was shown that treatment of the seeds with aqueous VP solutions results in the grafting of polyvinylpyrrolidone (PVP) on the seeds. With preliminary γ-ray treatment of the seeds, the degree of grafting increased from 0.2—12.2 to 0.2—21.8% of the seed weight. Study of the effects of the radiation dose (10—100 k-roentgen), concentration of the solution (0.5—10%), duration of the VP treatment (2—24 hrs), temperature (30, 50, and 70°C), and the presence or absence of air oxygen on the degree of grafting permitted the establishment of optimum grafting conditions for irradiated and nonirradiated seeds in the presence or absence of oxygen. The courses of the radiation initiation reactions are believed to be radical in nature; in the presence of oxygen the process consists in the destruction of peroxide compounds formed as a result of radiation. The effect of PVP grafting on biological functions was studied on both irradiated and nonirradiated seeds. The seeds were treated with aqueous VP solutions at 30°C in the presence of oxygen under various conditions. Study of the seeds' degree of survival, the growth of the coleoptiles, and the mitotic activity of the root cells showed that: solutions of VP with concentrations of up to 5% produce no harmful effect on the germination processes of nonirradiated seeds; and under specific optimum conditions aqueous VP solutions have a protective effect on irradiated seeds. This effect is due to the grafting of PVP on the seeds, which results in the suppression or weakening of processes which upset the natural development of the plant. Optimum protection was attained by treating the seeds for 4 hr with a 5% VP solution. (auth)

1461 USE OF RADIOISOTOPES IN IMMUNOCHEMICAL RESEARCH. Felix Haurowitz (Indiana Univ., Bloomington). 26p. of "Ergebnisse der Mikrobiologie Immunitätsforschung und Experimentellen Therapie." Berlin, Springer-Verlag, 1961. (In English)

Discussion is given on the preparation of isotopically labeled antigens, antibodies, and complement components; elimination of isotopically labeled antigens from the circulation; distribution and deposition of labeled antigens; metabolism of labeled antigens in sensitized animals; use of isotopically labeled antigens for the detection and determination of antibodies; use of labeled antibodies in immunological research; formation of isotopically labeled antibodies and their metabolism; determination of the half life and the breakdown of isotopically labeled antibodies; and investigations on isotopically labeled complements. 141 references are given. (P.C.H.)

Fallout and Ecology

1462 EFFECTS OF ARTIFICIAL Sr^{90} FALLOUT ON PLANTS. I. UPTAKE AND DISTRIBUTION OF Sr^{90}. E. G. Niemann (Technische Hochschule, Hanover). Atompraxis, 7: 370-5(Oct. 1961). (In German)

Model experiments were made with artificial Sr^{90} fall-out in order to study its uptake, distribution, and radiobiological effect in a plant (Arabidopsis thaliana L.) over several generations. The plants were raised in pot experiments under defined conditions. The Sr^{90} was applied as a solution through special jets in the form of fine precipitation. For the most part it was taken up directly into the plant via the leaves. Activity distribution in the soil corresponded approximately to an exponential decrease; a subsequent inactive spraying led to a leveling off in the upper soil layers. With uptake through the root, the Sr/Ca ratio in the plant corresponded to that of the top soil layer; with uptake through the surface of the leaves, it corresponded to that in the applied fall-out solution. The uptake of Sr^{90} in the plant did not increase in proportion to the Sr^{90} concentration in the fall-out. The selective enrichment of Sr^{90} in the plant material was in no case great enough to provide effective decontamination of the soil through plant growth. (auth)

Radiation Effects on Living Tissues

1463 (AF-SAM-61-72) LATE TESTICULAR LESIONS IN IRRADIATED MONKEYS (MACACA MULATTA). James A. Pitcock (School of Aviation Medicine. Aerospace Medical Center, Brooks AFB, Tex.). Feb. 20, 1961. 14p.

Prepubertal Macaca mulatta monkeys were exposed to acute and fractionated doses of gamma or neutron radiation or to both. Testicular tissues were examined 3 to 8 years later for the presence and severity of permanent lesions. The Macaca mulatta monkey is more sensitive to the permanently damaging effects of ionizing radiation than are the common small laboratory animals and may be comparable to man. Lesions were demonstrated in animals exposed to as little as 154 rep of gamma radiation and a threshold of 57 rep was estimated. The relative biological effectiveness for neutrons could not be determined, but it is probably less than 2. The degree of testicular damage is relatively independent of dose rate and fractionation but is dependent primarily on the cumulative dose administered. (auth)

1464 (ORNL-3189(p.179-90)) PHYSICS OF TISSUE DAMAGE. D. R. Nelson, R. D. Birkhoff, et al. (Oak Ridge National Lab., Tenn.).

Spectral studies were undertaken of the light emitted in fluorescence and thermoluminescence from trypsin, spores of Bacillus megaterium, and the amino acids L-tyrosine, L-phenylalanine, and L-tryptophan. In all cases spectral bands were found which were characteristic of the material irradiated and its temperature. The data revealed the existance and depth of metastable energy levels into which charge carriers are excited by the passage of x and gamma rays through these biochemicals. Those electronic rearrangements which are initiated in the interaction of ionizing radiation with trypsin become preferentially localized in a very restricted number of metastable configurations. The thermoluminescence from the molecular crystals of aromatic amino acids is not attributable to those electronic transitions which account for fluorescence and phosphorescence due to ultraviolet excitation. The energy resulting from the decay of the metastable configuration in trypsin may very well appear as tryptophan phosphorescence. Thus the recombination might involve either tryosine of phenylalanine, and energy transfer to tryptophan would then account for the predominant emission at 4600 A. With increasing temperature, the spectral distribution shifts toward longer wavelengths. The fact that these bands are shifted by as much as 0.6 ev makes it seem somewhat unlikely that this would represent an increasing partition of recombination energy into nonradiative modes. There was previously considerable controversy as to whether conduction bands exist in proteins. The present studies do not resolve this question. If such do exist, however, these results indicate that the conduction and filled bands must be separated by at least 2.7 ev in trypsin. (auth)

1465 (TID-13638) THE MUTATION RATE AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF DROSOPHILA. Eight Month Progress Report. (Turku, Finland. Univ.). [nd.] Contract AT(30-1)-2690. Subcontract 31R1/US.

The effects of radiation damage, as measured by mutation rates at specific visible autosomal loci, upon the male germ cells of Drosophila was studied with special emphasis upon comparative mutation rates of gametes in different stages of maturation at the time of radiation. Information on the brood patterns, and data on the kind and incidence of mutations as related to the brood patterns are summarized. A clearly defined reduction in number of offspring was found to occur in the third brood (6 to 8 days following radiation) although the number of offspring is also considerably reduced in the fourth brood. The data point to a difference in mutation patterns as well as mutation rates for the three types of mutations. The numbers are large enough for the first two broods to make it highly probable that the difference between the mutants at specific loci, and the phenotypic dominants is more than just a quantitative difference. In respect to the gonadal periods, it appears that the mutation rate of the Minutes may be considerably higher than of the other types of mutations. It is also suggested that there may be a difference in mutation rates in gonadal cells in different developmental stages at the time of radiation. (P.C.H.)

1466 (TID-13639) STUDY AND COMPARISON BETWEEN NECROLYTIC AND RADIOLYTIC LESIONS AT THE MITOCHONDRIA LEVEL (LYSOSOMES) IN ASEPTICAL PERFUSED BEEF HEART MUSCLE. First 8 Months Progress Report. [B. de Bernard] (Trieste. Università. Istituto di Chimica Biologica). [nd.]. Contract AT(30-1)-2632, Subcontract 69/US. 19p.

Beef heart homogenate was prepared in which the acid hydrolases were completely bound to sedimentable particles. The activities of beta-glucronidase, acid phosphatase, and cathepsins in the homogenate were shown to be nil. In other research, procedures for fractionation of beef heart homogenate were developed, and the catheptic activity of beef heart mitochondria was examined. It was concluded from research results that irradiation with x rays does not denature the catheptic enzyme inside its particle. Data on enzyme activities, centrifugal beef heart fractionation, and enzyme distribution are included. (J.R.D.)

1467 (TID-14093) RELATION OF RICKETTSIAL AND VIRAL INFECTIONS TO RADIATION INJURY AND FREEZE-DRYING OF CELLULAR PARTICULATES. Progress Report, January 1, 1961 to September 15, 1961. Donald Greiff (Marquette Univ., Milwaukee. School of Medicine). Oct. 1961. Contract AT(11-1)-596. 15p.

In an investigation of phosphorylation by mitochondria following freezing and drying it was found that mitochondria are best prepared in isotonic sucrose. Preliminary dehydration was found to be essential for the preservation of mitochondria oxidative phosphorylation activities, and rehydration was found essential to prevent disruption of the mitochondrial elements. Data from these investigations are tabulated. Other work was done in the areas of plaque formation and cytopathic effects of rickettsial in monolayer tissue cultures, and on the effects of x rays on the levels of lactic dehydrogenase, glutamic-oxalacetic transaminase, and glutamic-pyruvic transaminase in the embryonate egg. Research results on the distribution of tritiam oxide in developing embryonate eggs are also included. (J.R.D.)

1468 (TID-14094) INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Summary of the Results up to June 30, 1961 (Nine Months of the Term of Contract). R. E. Scossiroli (Pavia, Italy. Università. Istituto di Genetica). Aug. 1, 1961. Contract 61/US. 9p.

The research program carried out on the x irradiation of plants, e.g., corn, wheat, and tobacco, is described, and the budget and program proposed for the following year are outlined. (D.L.C.)

1469 (AEC-tr-4673) INVESTIGATION OF THE CHEMICAL COMPOSITION OF THE CRYSTALLINE LENS OF THE EYE IN RADIATION CATARACT. A translation of "Izuchenie Khimicheskogo Sostava Khrustalika Glaza pri Luchevoi Katarakte." A. A. Chubakov and L. M. Luzanova (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 19p.

Investigations of the chemical composition of the crystalline lens of the rabbit in radiation cataract are reported. It was established that when the lens become cloudy, the potassium content is depleted and the content in chlorine and sodium is enriched. Similar changes are observed also in case of senile cataract. Change of the chemical composition of the lens takes place simultaneously with the opacity. The data obtained on the chemical composition of the vitreous body show that nourishment of the crystalline lens by sodium and by chlorine takes place across the vitreous body while the sodium is supplied across the liquid in the anterior chamber. (auth)

1470 (JPRS-10170) RADIOBIOLOGY. A. M. Kuzin, ed. Translation of Radiobiologiya, 1: No. 1, 1961. 461p.

Included are 26 papers concerned with the biological aspects of radiation effects on animal and plant species. Separate abstracts were prepared for all papers. (B.O.G.)

1471 (JPRS-10170(p.1-23)) ON THE ROLE OF RADIATION INJURY OF INTRACELLULAR INTERFACES IN THE BIOLOGICAL ACTION OF IONIZING RADIATIONS. A. G. Pasynskii (Pasynskiy). Translated from Radiobiologiya, 1: No. 1, 3-9(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 30416.

1472 (JPRS-10170(p.24-37)) STRUCTURAL CHANGES OF DNA IN RAT ORGANS AFTER WHOLE-BODY IRRADIATION. A. M. Kuzin, N. B. Strazhevskaya, and V. A. Struchkov. Translated from Radiobiologiya, 1: No. 1, 10-13(1961).

Modifications of the phenol method for isolation of DNA permitted the extraction of high-polymer preparations of DNA from the liver, thymus, and spleen of rats at, normalized viscosities of, $\eta_{sp/struc}$ = 80 to 110, while excluding their enzymatic degradation in the isolation process. A 50% decrease in the viscosity of DNA in the thymus 2 to 4 hours after irradiation was noted for 1000 r doses. The DNA viscosity from the liver and spleen did not change during 24 hours after irradiation at 1000 r, although a progressive decrease in content was observed. Irradiations at 20,000 r brought about immediate and sharp decreases in viscosity which was identical for all three organs observed. (B.O.G.)

1473 (JPRS-10170(p.38-68)) SIMILARITY IN THE MANIFESTATION OF RADIATION AFTEREFFECT IN PROTEINS OF DIFFERENT STRUCTURE (COMPARATIVE INVESTIGATION OF MYOSIN AND PEPSIN). E. (Ye). E. Ganassi, N. V. Kondakova, G. K. Otarova, and L. Kh. Eidus (Eydus). Translated from Radiobiologiya, 1: No. 1, 14-22(1961).

The irradiation behavior of globular pepsin was studied to compare the results with the phenomena observed previously with myosin. The results confirm the similarity of the properties discovered in myosin for a wider range of protein molecules. The thermal aftereffect for the two proteins is caused by the transition of protein by irradiation into a state with a low activation barrier of thermoactivation. The activation energies for the thermal aftereffect are 40 and 13 kcal/mole, respectively, for pepsin and myosin. The qualitative difference in the behavior was observed only in relation to the oxygenic aftereffect. (B.O.G.)

1474 (JPRS-10170(p.69-89)) DEGRADATION OF POLYNUCLEOTIDES AND THEIR PRECURSORS UNDER THE EFFECT OF GAMMA-IRRADIATION. A. V. Savich and M. I. Shal'nov. Translated from Radiobiologiya, 1: No. 1, 23-9(1961).

The dependence of the destruction yield of the chromophore group of polynucleotides and their precursors in aqueous solutions was studied for uracil, uridine, 3-allyl-4-aminouracil, and sodium ribonucleate at concentrations of 10^{-5} to 5×10^{-3} mole/liter. The dependence of the dose of 37% conservation on the initial concentration under the effects of gamma rays was established for doses of 2 to 500 krads at a rate of 380 rads/min. The maximum values of the radiative-chemical yields of indirect action, G_H, was calculated. The yields for pyrimidines are higher than for purines and the yield diminishes on addition of any additional atomic group to the pyrimidine ring. The yield for sodium ribonucleate, which represents a model of polynucleotide, has low values compared to the other substances investigated, which are the precursors of RNA in nucleic biosynthesis. (B.O.G.)

1475 (JPRS-10170(p.90-110)) EFFECT OF RADIOPROTECTIVE SUBSTANCES UPON THE SURFACE LAYER OF ERYTHROCYTES. K. S. Trincher and A. M. Kuzin. Translated from Radiobiologiya, 1: No. 1, 30-6(1961).

The effects of cystamine, AET, ascorbic acid, adrenaline, morphine, nembutal, glucose, and blood serum on the surface layer of erythrocytes were investigated. In the absence of serum proteins, cystamine, AET, ascorbic acid, and adrenaline damage the surface of nonirradiated erythrocytes, similarly to the damage caused by ionizing radiation. The serum proteins protect the surface of erythrocytes both against the damaging action of the chemical substances as well as radiation. An hypothesis on the role of the water-soluble proteins in the natural and artificial protection of intracellular structures against the action of ionizing radiation was formulated. (B.O.G.)

1476 (JPRS-10170(p.111-27)) STUDY OF STRUCTURAL CHANGES IN PLANT TISSUE BY THE IMPEDANCE METHOD UNDER THE ACTION OF IONIZING RADIATION. E. (Ye.) V. Budnitskaya, N. M. Maslov, I. G. Borisova, and A. G. Pasynskii (Pasynskiy). Translated from Radiobiologiya, 1: No. 1, 37-41(1961).

The effects of steaming, wilting, trituration, and radiation on the electric resistance of bean leaves were measured at frequencies of 0.5 to 100 kcps. The decrease of resistance dispersion is distinctly manifested at doses of 25,000 r. The effects of higher doses cause structural disintegration of plant tissue analogously to the action of direct mechanical homogenization. (B.O.G.)

1477 (JPRS-10170(p.128-34)) CYTOCHEMICAL CHANGES IN THE NERVOUS SYSTEM OF MAMMALS UNDER THE EFFECT OF LOCAL X-RAY IRRADIATION. (Preliminary Report). A. L. Shabadash, T. I. Zelikina, and N. D. Agracheva. Translated from Radiobiologiya, 1: No. 1, 42-4(1961).

Experiments were carried out to determine the effects of screening of various parts of the body on the direct and distant influences on the nervous system caused by the whole-body irradiation of rats. The screening caused decreases in the cytochemical changes in the nerve cells of the portions of the central nervous system located in the screened zones. Observations conducted during the first 30 min distinctly revealed the various distant effects. (B.O.G.)

1478 (JPRS-10170(p.135-57)) EFFECT OF THE DOSE RATE OF IRRADIATION UPON THE ELECTRICAL CONDUCTANCE OF THE CEREBRUM IN RATS. Z. I. Apanasenko. Translated from Radiobiologiya, 1: No. 1, 45-51(1961).

The study was conducted to elucidate the qualitative and quantitative differences in radiation responses on the nervous system on rapid and prolonged irradiations with the same dose. Dose rate changes exert an essential effect on the character of radiation reactions of the organism, such as electrical conductivity of the cerebrum, condition of the peripheral blood, and survivability of rats. Irradiations of 600 r at 600 r/min proved more effective on hematological indexes, severity of radiation sickness, and survivability, while at rates of 0.5 r/min were more effective on changes of electrical conductivity of the cerebrum. (B.O.G.)

1479 (JPRS-10170(p.158-77)) ON THE PROBLEM OF THE PHYSIOLOGICAL REGENERATION OF EPITHELIAL CELLS OF THE CORNEA IN IRRADIATED MICE. G. P. Gruzdev. Translated from Radiobiologiya, 1: No. 1, 52-7 (1961).

A study was made of the problems concerning the dynamics of disturbance of cell division and the significance of this disturbance in those shifts of physiological functions observed in irradiated animals. Total gamma doses of 750 r cause sharp disturbances of regenerative processes in corneal tissues of white mice: the total number of epithelial cell elements decrease; the diminishing process of the number of epithelial cells proceeds more sharply in the central areas of the cornea and more weakly in its peripheral fields; the total number of mitoses decrease; initially the mitotic index decreases and is restored to a normal level by the fifth day of radiation sickness; and by the fifth day of sickness, a disturbance in the daily rhythm of the fluctuations of the number of mitoses is observed. (B.O.G.)

1480 (JPRS-10170(p.178-97)) EFFECT OF DOSE FRACTIONATION UPON UNCONDITIONED REFLEX ACTIVITY OF THE SPINAL CORD IN RABBITS FOLLOWING WHOLE-BODY X IRRADIATION. M. A. Kuznetsova. Translated from Radiobiologiya, 1: No. 1, 58-64(1961).

An investigation was initiated to determine the role of the time factor in the effects of x rays on the functions of the spinal cord. Irradiation in fractionated doses of 10 r five times a week produces disturbances of reflex activity. During the irradiation period observations were made of a phase of its relative normalization against the background of disturbed reflex activity. The fractionation of the dose under given conditions for the hematopoietic system substantially attenuates the radiation reaction, while the divided dose has no attenuating effect on the spinal cord. The absence of the attenuating effect on the spinal cord coincides with data for the effects on the radiation reaction of the cortex of the cerebral hemispheres, which leads to the assumption that the existence of common norms in the reactions of these portions of the central nervous system (CNS) to the effect of x rays. Inasmuch as the time factor exerts a different effect on the CNS than on other systems, consequently the known data concerning the attenuation effect of radiation fractionation, obtained for radiation reactions of the blood and those relating to survivability, cannot be extrapolated to the reactions of the CNS. (B.O.G.)

1481 (JPRS-10170(p.198-212)) ON THE ACCUMULATION OF STRONTIUM-90 IN BONES OF RATS AND KINETICS OF ITS ELIMINATION. Yu. I. Moskalev. Translated from Radiobiologiya, 1: No. 1, 65-9(1961).

Observations were made of the Sr^{90} metabolism in rats for 626 days following intraperitoneal administration. Approximately 62% of the Sr^{90} injected is deposited in the skeleton; of which 63% is eliminated within the biological period of semi-elimination of $\sim$65 days, and 37% within the semiperiod of 680 days. Growth rates cause the activity concentration in one tissue to fall more rapidly than the content in the entire skeleton. The concentration in the bones from 300 to 600 days is 3 to 4 times higher than in the liver, kidneys, spleen, and muscles. The values of deposition and rate of elimination from the bone tissue within the range of dose studies, 1000 μc per rat, do not depend on the quantity of the activity introduced. (B.O.G.)

1482 (JPRS-10170(p.213-19)) FORMATION OF ORGANIC PEROXIDES IN THE ORGANISM OF MICE AT DIFFERENT PERIODS OF RADIATION SICKNESS. Z. I. Zhulanova. Translated from Radiobiologiya, 1: No. 1, 70-2(1961).

A study was made of the formation of organic peroxides in the organs of mice at different periods following irradiation for 30 sec to 72 hr. Following irradiation with x rays for a dose of 1300 r at 130 r/sec, increases in peroxide formation were observed immediately after irradiation and 24 hr, and a considerable increase after 72 hr, the terminal period. After 30 and 60 min, and 3 hr the peroxide formation was within normal. The data indicate a two-phase peroxide formation during an acute radiation sickness. (B.O.G.)

1483 (JPRS-10170(p.220-33)) EFFECT OF PROTECTIVE SUBSTANCES AND HYPOXIA UPON THE FORMATION OF ORGANIC PEROXIDES. E. (Ye.) F. Romantsev and Z. I. Zhulanova. Translated from Radiobiologiya, 1: No. 1, 73-7(1961).

A study was made of the effects of protective substances (L-cysteine and β-mercaptoethylamine (MEA)) and hypoxia, on the formation of organic peroxides in mice irradiated with x rays for 1300 r at a rate of 130 r/sec. The administration of L-cysteine and MEA in quantities exerting prophylactic action against x rays causes a decrease of the formation of peroxide-like compounds in the carcasses of healthy and irradiated mice. The decrease is observed 5 and 20 min following the administration of the compounds. The maintenance of animals in an atmosphere with a decreased O_2 content (10%) causes an analogous decrease of peroxide-like compounds; however the decrease is less marked. (B.O.G.)

1484 (JPRS-10170(p.234-56)) TOXIC EFFECT OF OLEIC ACID AND OF THE PRODUCTS OF ITS OXIDATION. On the Problem of the Cytotoxic Factor in Radiation Injury of Animals. Yu. B. Kudryashov, V. Mal'ts, E. (Ye.) N. Goncharenko, M. L. Kakushkina, B. A. Lomsadze, Wen-tiuan Hsing, Yu-hua Hsueh, and Chen-lien Chang. Translated from Radiobiologiya, 1: No. 1, 78-85(1961).

Oleic acid was irradiated at 514 kr and oxidized in darkness at 60°C. Samples taken at various stages of oxidation were analyzed for acid and iodine numbers, and the amounts of peroxides, epoxides, aldehydes, and ketones. The toxicity of the samples on organisms, enzymatic systems, and erythrocytes in rats was studied. On intraperitoneal administration injuries developed in the rats, bringing about their death. The terminal oxidation products, aldehydes and ketones, were found to apparently possess the highest toxic effect. The substances were able to disturb the autolysis processes in the liver in vitro. The inhibition of the autolytic reaction is attributed to the accumulation of aldehydes and ketones. The change of hemolytic activity in the oxidation of oleic acid is apparently consequential on the accumulation of peroxides. The cytotoxic factor formed in the tissues of irradiated animals may be assumed to represent the oxidized products of unsaturated fatty acids. (B.O.G.)

1485 (JPRS-10170(p.257-78)) ON THE POSSIBILITY OF USING TISSUE HEMOLYSINS AS AN INDICATOR OF THE EFFECTIVENESS OF RADIOPROTECTIVE PREPARATIONS. V. V. Antipov. Translated from Radiobiologiya, 1: No. 1, 86-92(1961).

An investigation was made of the use of the dynamics of the hemolytic factor for the evaluation of the protective effectiveness of mercamine and ionol in the x-ray irradiation of rats. Tissue hemolysins found in the liver extracts of the rats are formed in vitro in the process of incubation and cold storage of the extracts. No correlation was discovered between the effectiveness of the prophylactic action of radioprotective agents and their ability to inhibit the formation of hemolysins. The results do not provide grounds to ascribe to hemolytically active substances the role of cytotoxins in the pathogenesis of radiation injury. (B.O.G.)

1486 (JPRS-10170(p.279-312)) RELATIVE GENETIC RADIOSENSITIVITY OF VARIOUS SPECIES OF MAMMALS. N. I. Shapiro, E. (Ye.) D. Plotnikova, S. I. Strashnenko, and V. I. Suslikov. Translated from Radiobiologiya, 1: No. 1, 93-103(1961).

The study was made to characterize the rate of mutation processes induced by x rays in mice, rats, and rabbits. The dominant lethal factors were used as an indicator of the genetic changes caused by the x rays. The frequency of occurrence of the dominant lethal factors in the irradiated animals may be arranged in the order of increasing genetic radiosensitivity: mice < rat < rabbit. Characteristics of the investigated species of gnawing mammals are a definite frequency of occurrence of dominant lethal factors per unit of irradiation dose, and the time of action of mutations in ontogenesis. In rabbits the induced dominant lethal factors in a majority of cases cause the death of embryos before implantation, while death occurred after implantation in mice and rats in the dose range studied. (B.O.G.)

1487 (JPRS-10170(p.313-34)) ON THE EFFECT OF IONIZING RADIATION UPON MITOTIC ACTIVITY OF CELL POPULATION AT THE STAGE OF EXPONENTIAL GROWTH. A. D. Strzhizhovskii (Strzhizhovskiy). Translated from Radiobiologiya, 1: No. 1, 104-11(1961).

A statistical investigation was made of the effects of ionizing radiation on mitotic activity and the growth rate of cell population at the stage of exponential growth. A scheme of radiation damage of the cell was examined, and expressions were derived for the variation of the number of cells of the population and its mitotic acitivity depending on time and dose of the irradiation. An analysis of the derived equations was made. (auth)

1488 (JPRS-10170(p.335-60)) RADIOSENSITIVITY OF STRAINS AND SPECIES OF ACTINOMYCETES IN CONNECTION WITH THE PECULIARITIES OF THE STRUCTURE OF THEIR NUCLEAR ELEMENTS. A. A. Prokof'eva-Bel'govskaya (Prokof'yeva-Bel'govskaya), O. N. Kapitonova, and Z. B. Shamina. Translated from Radiobiologiya, 1: No. 1, 112-18(1961).

Cytological and cytochemical analyses were made of nine strains pertaining to four species of actinomycetes producing streptomycin, aureomycin, erythromycin, and oxytetracycline toward clarifying the number of nuclear elements in irradiated cells, their dimensions and DNA contents. Differences in the sensitivity of the strains to the action of ultraviolet and x rays were demonstrated to be distinctly connected with the differences in the number or size of nuclear elements in irradiated cells, viz.: the increase of the number of nuclear elements or augmentation of their dimensions is accompanied by increases in cell resistance to the radiation. The radiosensitivity of actinomycetes, as well as that of animals and plants, presents a very complex phenomenon in which hereditary factors, the medium factor, and the age of the organism are of great importance. (B.O.G.)

1489 (JPRS-10170(p.361-72)) EFFECT OF FRACTIONATION OF THE GAMMA-RAY DOSE UPON THE FREQUENCY OF OCCURRENCE OF MUTATIONS IN SPERMATIDS OF DROSOPHILA MELANOGASTER. Ya. L. Glembotskii (Glembotskiy), E. A. Abeleva, and Yu. A. Lapkin. Translated from Radiobiologiya, 1: No. 1, 119-22(1961).

Observations made of the disturbance of the linear dependence of the frequency of occurrence of recessive lethal mutations linked with sex on 1000 to 2000 r doses in the irradiation of *Drosophila* rendered scarcely probable the hypothesis of Russell according to which the retardation of the frequency of mutations from the dose on its increase is explained by the death of the most mutable cells. The disturbance is completely preserved for 2 kr doses administered fractionally at 1 kr, with a three-hour interval between irradiations. The analogous disturbance of linear dependence was observed for dominant lethal factors. The frequency of recessive lethal genes was found not to decrease on dose fractionation. The similar character of the dose dependence of the frequency of occurrence of dominant and recessive lethal mutations may be explained by a common cause producing the disturbance of the linear frequency of the mutations on the dose. (B.O.G.)

1490 (JPRS-10170(p.373-86)) OCCURRENCE OF MUTATIONS IN NONIRRADIATED CHROMOSOMES OF OVICELLS FERTILIZED BY IRRADIATED MALE GAMETES. E. A. Abeleva, M. L. Bel'govskii (Bel'govskiy), and N. A. Potekhina. Translated from Radiobiologiya, 1: No. 1, 123-7(1961).

The occurrence of mutations in unirradiated ovicell chromosomes fertilized with irradiated male gametes points to the possibility of a prolonged preservation and transmission of energy from structure to structure. The effect described does not depend on the peculiarities of the structure of the chromosome in which mutations occur. In contrast to what is observed in irradiated chromosomes, the effect in unirradiated chromosomes is greater on the irradiation of spermia than on spermatids. The general effect of radiation on spermia and spermatids is the same. (B.O.G.)

1491 (JPRS-10170(p.387-404)) CHANGES IN THE POLLEN GRAINS OF RYE PLANTS EXPOSED TO THE CONTINUOUS ACTION OF GAMMA RAYS. L. P. Breslavets, Z. F. Mileshko, and L. M. Kryzhanovskaya. Translated from Radiobiologiya, 1: No. 1, 128-34(1961).

A study was made of the effects of continuous and prolonged irradiation, at 18 to 50 r, on the morphological and physiological properties of the pollen grains of rye plants. Decreases in the cropping power, observed in single irradiations in excess of 2000 r, are widespread during the prolonged irradiations. It is concluded that, while determining the harmful consequences of the prolonged action of the small irradiation dose, the radiosensitivity data obtained in short-lived irradiations cannot be relied upon. (B.O.G.)

1492 (JPRS-10170(p.405-17)) SIGNIFICANCE OF THE DISTURBANCE OF METABOLIC REACTIONS IN RADIATION DAMAGE OF SEEDS. N. M. Berezina and V. A. Yasykova. Translated from Radiobiologiya, 1: No. 1, 135-8(1961).

The x irradiation of dry seed corn in 40-kr doses caused disorders of metabolic reactions which were expressed by an earlier conversion of starch to dextrin and sugar, a more intensive accumulation of sugars, and a higher content of fats in the irradiated plantules. Cytological investigations established sharp disorders in the course of mitoses and the retardation of the start of division in the irradiated plantules. The growth of the irradiated embryo on artificial media considerably attenuated the damaging effect of radiation, viz., a lethal dose of 40 kr caused 100% fatality of the irradiated plantules grown from intact seeds on the 13th day, whereas the embryos irradiated with the same dose and grown on an artificial medium vegetated 1 to 1.5 months, blossomed, and bore fruit. (B.O.G.)

1493 (JPRS-10170(p.418-22)) FORMATION OF ANTIMITOTIC SUBSTANCES IN DIFFERENT SPECIES OF PLANTS UPON IRRADIATION. L. M. Kryukova. Translated from Radiobiologiya, 1: No. 1, 139-40(1961).

An investigation was made to determine whether the formation of antimitotic substances on irradiation of plants is specific for a given species, *Vicia faba* (broad bean), or whether the phenomenon represents a common pattern of the change of the metabolism for other plant species. Broad bean plantules, 3 to 4 days old, were immersed in extracts made from leaves of irradiated, 2-week-old sunflower, wild radish, scarlet runner, melon, cucumber, garden pea, corn, pumpkin, and broad bean plants. Mitotic indexes were determined in the radicals 24 hr after immersion. The appearance of the antimitotic substances in the irradiated plants was concluded not to be a specific phenomenon only for the broad bean, but represents a regular change in the metabolism of irradiated plants. (B.O.G.)

1494 (JPRS-10170(p.423-48)) DOSIMETRY IN EXTERNAL ALPHA IRRADIATION. G. B. Radzi'evskii (Radziyevskiy). Translated from Radiobiologiya, 1: No. 1, 141-8(1961).

A method is described using an extrapolation chamber with a diaphragm which permits the measurement of the power of the absorbed dose in air near a distributed soft alpha source, and of the distribution of the absorbed dose according to the depth of the object. Measurements were carried out for the curves of depth doses in plexiglas and aluminum, and the values of the relative mass stopping powers were determined from 1 to 4 Mev. A comparison was made of the present method with a difference method for the dosage distribution measurements in an irradiated object. and a satisfactory coincidence of results was obtained. (B.O.G.)

1495 (JPRS-10170(p.449-53)) SPECTRA OF ELECTRONIC PARAMAGNETIC RESONANCE OF HIPPURIC ACID IRRADIATED WITH Co^{60} GAMMA RAYS. M. P. Votinov, E. (Ye.) M. Lapinskaya, M. A. Khenokh, V. F. Evdokimov (Yevdokimov), V. V. Antuf'ev (Antuf'yev), and A. V. Stafeev (Stafeyev). Translated from Radiobiologiya, 1: No. 1, 149-50(1961).

A study of the EPR spectra of hippuric acid revealed a hyperfine structure composed of five lines with uneven splitting and intensity distributions close to 1:3:6:3:1, and with a g-factor value of 2 at the center of the signal. A slight asymmetry of the spectrum is apparently caused by the presence of peroxide-type radicals in the system. Increases in the dose preserve the character of the spectrum. The intensity of the spectrum and the radical concentration increases linearly with the dose. The character of benzoic acid and glycine was also studied. (B.O.G.)

1496 (JPRS-10170(p.454-7)) DETECTION OF CHEMOLUMINESCENCE IN THE LIVER OF IRRADIATED MICE. B. N. Tarusov, A. I. Polivoda, and A. I. Zhuravlev. Translated from Radiobiologiya, 1: No. 1, 150-1(1961).

A method is described for the detection of chemoluminescence occurring in oxidation reactions in the liver of mice irradiated by x rays. The livers of control mice were found to emit a weak radiation, while the irradiated animals, especially at early periods, emit much stronger radiation, which surpasses that of the background. The maximum of the radiation was found to lie in the region of 4600 to 5000 Å. The radiation is absent in the region above 5500 Å. In the first approximation, the spectra characteristic corresponds to the spectrum of the chemoluminescence of fats. (B.O.G.)

1497 (JPRS-10440) CHANGES IN LIPOPROTEINS OF TUMORS UNDER THE EFFECT OF GAMMA RAYS. A. M. D'yakova. Translated from Ukrain. Biokhim. Zhur., 33: 352-61(1961). 14p.

The character of changes in the lipid part of tumor lipoproteins under the effect of therapeutic doses of gamma radiation and the dependence of these changes on the protein component of tumor lipoproteins were investigated. The lipoproteins studied were isolated from tissues of reinoculated M-1 rat sarcomas. Upon gamma irradiation of M-1 rat sarcomas, the amount of lipoids increased in the lipoalbumins and liponucleoproteins of the tumors. The increased lipoid content was caused in lipoalbumins by the enhancement of the quantity of cholesterol and phosphatides, and in liponucleoproteins chiefly by the increase of cholesterin. These changes in the lipoproteins of tumors took place after irradiation with 900 or 2500 r doses. An increase of the lipoid content of the nucleoproteins took place only in cases of retardation of the tumor growth. The lipoid content in albumins increased after irradiation, independently of the rate of tumor growth. (M.C.G.)

1498 (JPRS-10469) ON REACTIONS OF THE ORGANISM TO THE ACTION OF SMALL DOSES OF IONIZING RADIATION. M. G. Durmish'yan. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 3, 386-410(1961). 78p.

The biological actions of small doses of internal irradiation from Na^{24} and P^{32} on rats, rabbits, and dogs were studied to determine the comparative radiosensitivity of various organs and systems, the significance of the age factor in the radiosensitivity of the organism, peculiarities of multiple and chronic action of extremely small activities of radioisotopes, peculiarities of the combined action of radioisotopes and factors of nonradioactive nature, and the norms of the elimination of radioisotopes from the organism. (B.O.G.)

1499 (JPRS-10673) TRANSLATIONS FROM "PROBLEMS OF ESOPHAGEAL AND GASTRIC SURGERY: THE BIOLOGICAL EFFECT OF 25 MEV BETATRON RAYS." I. V. Toroptsev, E. (Ye.) D. Gol'dberg, et al. Translation of p.485-535 from "Voprosy Khirurgii Pishchevoda i Zheludka: Biologicheskoye Deystviye Luchey Betatrona 25 Mev, Tomsk." 1960. 51p.

A translation of nine selected articles from the book Problems of Esophageal and Gastric Surgery: The Biological Effect of 25 Mev Betatron Rays is presented. The following topics are covered: some results of work of the Betatron Laboratory at the Tomsk Medical Institute, hematologic changes in guinea pigs with the acute forms of radiation sickness caused by the 25-Mev betatron, the mechanism of action of betatron rays with an energy of 25 Mev on the vitamin B_{12} metabolism in the body, the reaction of the peripheral blood after experimental irradiation of the pharyngeal lymphoid tissue with a 25-Mev betatron, disturbance of vitamin C deposition in guinea pigs after irradiation with gamma radiation of a 25-Mev betatron, the excretion of bile after local irradiation of the liver with a 25-Mev betatron, some biochemical indices obtained in persons working with the betatron and patients irradiated with betatron rays for treatment purposes, observation on treatment of a sarcoma in a dog with 25-Mev betatron rays, and experience in the utilization of the betatron for the treatment of malignant tumors. (M.C.G.)

1500 RADIATION EFFECTS OF NEUTRON-CAPTURE THERAPY ON A MALIGNANT VASCULAR NEOPLASM OF THE CEREBELLUM. Histopathological Observations. Stuart W. Lippincott, Lucas Yamamoto, and Lee E. Farr (Brookhaven National Lab., Upton, N. Y.). A.M.A. Arch. Pathol., 69: 44-54(Jan. 1960).

The direct irradiation effects on tissue from energetic heavy particles (alpha and lithium) following neutron-capture therapy are presented in studies of biopsy tissues on an 11-year-old child with a malignant vascular neoplasm of the cerebellum. (auth)

1501 DOSE FACTORS AND MORPHOLOGY OF DELAYED RADIATION LESIONS OF THE INTERNAL AND MIDDLE EAR IN RABBITS. Nils O. Berg and Martin Lindgren (University Hospital, Lund, Sweden). Acta Radiol., 56: 305-19(Oct. 1961). (In English)

Vestibulo-cerebellar signs and morphologic changes in the ear of the rabbit were observed following x irradiation (200 kv) of half the brain. A single dose of 2500 r or more complicated the histologic appearances by producing septic lesions in the middle ear and labyrinth. After fractionated irradiation such complications were rare, but radionecrosis apparently caused by primary vascular lesions was evident in the labyrinth. (auth)

1502 EFFECTS OF GAMMA RADIATION ON ISOLATED SURVIVING ARTERIES AND THEIR VASA VASORUM. Durwood J. Smith (Univ. of Vermont, Burlington). Am. J. Physiol., 201: 901-4(Nov. 1961).

The effects of irradiation with Co^{60} on 136 swine and dog carotid arteries were studied in vitro, utilizing an angioplethysmokymographic technique. In 20 to 40% of the specimens a slight vasoconstriction of the arterial wall was observed. This began and was completed within the first 60 sec of irradiation. Mounting the tissue in mineral oil did not prevent this reaction. Marked reductions in vasa vasorum flow were observed in swine carotids (70% decrease) and dog carotids (50% decrease) exposed to 9390 r of γ radiation during 15 min. Less marked, although significant, decreases in vasa vasorum flow were seen in swine arteries exposed to 3000 r, 2085 r, and 1500 r. No significant decreases were observed in 24 arteries exposed to 843 r. Swine arteries exposed to 9390 r, while mounted in mineral oil, did not show a significant decrease in vasa vasorum flow. It is concluded that the contraction of the arterial wall was a direct effect of radiation upon the vascular smooth muscle and that the observed decrease in vasa flow was probably secondary to ionization of the Tyrode's solution surrounding the artery. (auth)

1503 INTESTINAL VASCULAR PERMEABILITY CHANGES INDUCED BY RADIATION OR NITROGEN MUSTARD. Maurice F. Sullivan (General Electric Co., Richland, Wash.). Am. J. Physiol., 201: 951-4(Nov. 1961).

The appearance of an I^{131}-labeled plasma protein substitute, polyvinylpyrrolidone (PVP), in the gastrointestinal tract was increased following x irradiation or nitrogen mustard treatment of rats. Previous work suggests that leakage of PVP into the intestine may be used as an index of capillary permeability to large molecules. On this basis radiation and nitrogen mustard appear to act by a common mechanism and vascular permeability, as indicated by the similarity in the magnitude and duration of response to them. Partial-body irradiation showed that the upper small intestine was probably the principle site of leakage, and that the effect was caused by direct action on the intestinal epithelium. It was not caused by an increased excretion in the bile nor by an accumulation of secretions which were not reabsorbed because of impaired mucosal function. Treatment of x irradiated animals with hesperidin-ascorbic acid, diisopropylfluorophosphate, or serotonin had no effect on PVP excretion but prophylactic administration of cysteine did decrease leakage. (auth)

1504 KINETICS OF RETICULOENDOTHELIAL PHAGOCYTIC RESPONSE TO INTRAVENOUSLY ADMINISTERED Au^{198} COLLOIDAL GOLD IN RABBITS. O. M. Meredith, Jr. (Univ. of California, Los Angeles). Arch. Biochem. Biophys., 95: 352-62(Nov. 1961). (UCLA-463)

Phagocytosis of colloidal radiogold-Au^{198}, observed in the intact animal by external scintillation detection techniques, proceeds according to kinetic relations which are compatible with direct observations of the physiological process. The cellular engulfment of colloidal-sized material by the von Kupffer cells of the liver was described to occur in two stages: adherence of the particle to the surface of the cell, and then engulfment. Rate measurements of the blood disappearance and of the hepatic deposition of colloidal radiogold-Au^{198} are shown to conform with the kinetic model of the Michaelis-Menten relation: a reversible reaction complex is formed by combination of a reactant with a reaction site (such as a reaction center on an enzyme) and a nonreversible reaction follows. This parallelism between description of an event and the kinetics determined indirectly recommends reliability of the experimental method employed here for investigation of the phagocytic capacity of the von Kupffer cells of the reticuloendothelial system. These experimental measurements also conform with concepts developed for disappearance of I^{131}-tagged denatured serum albumin and carbon particles from the blood stream reported by Halpern and coworkers. (auth)

1505 THE INFLUENCE OF RADIOPHOSPHORUS THERAPEUTICS ON THE PERIPHERAL BLOOD IN THE CASE OF POLYCYTHEMIA AND EARLY IDENTIFICATION OF BLOOD-PICTURE ALTERATIONS. E. H. Graul and K. Damminger (Phillips-Universität, Marburg/Lahn, Ger.). Atompraxis, 7: 361-6(Oct. 1961). (In German)

The alterations of the peripheral blood picture of 17 patients, who were treated with radiophosphorus (P^{32}) for polycythemia are described. Within the first 24 hours after the intravenous injection of 5 mc of P^{32} the cell-numbers in the capillary-blood diminish. The effect is most obvious for the thrombocyte-number. By electronic counting and measuring, this radiation effect on the blood cells can be represented by a curve, which is obtained in the short time of 10 sec with a precision better than 1%. Striking is the alteration of the distribution curve of the erythrocytes, which seems to speak for an elimination of microcytous forms out of the peripheral blood and, by that, for a normalization. The importance of the method, with regard to its use in times of a catastrophe which allows to detect a radiation exposition of less than 10 r, is pointed out. (auth)

1506 ELECTROENCEPHALOGRAPHIC EFFECTS OF 900 MeV ALPHA-PARTICLES ADMINISTERED TO THE BRAIN OF RATS. G. M. Tisljar-Lentulis (Univ. of California, Berkeley). Atompraxis, 7: 367-70(Oct. 1961). (In English)

A set-up is described which makes it possible to record electrocorticograms during brain irradiation. The effects of high doses of 900 Mev alpha particles are discussed. Irradiation of one hemisphere alone did not cause any significant EEG-changes contralaterally after pre-irradiation of the corpus callosum. (auth)

1507 THE COMBINED EFFECT OF X-RAYS AND E 39 ON CELL RESPIRATION. R. Koch, D. Klemm, and J. W. Woenckhaus (Universität, Freiburg i. B. and Universitätsklinik, Freiburg, i. B.). Atompraxis, 7: 376-8 (Oct. 1961). (In German)

The separate and combined effects of x rays and E 39 on respiration in tumor cells and radiosensitive normal cells is discussed. It was found that E 39 causes greater respiratory inhibition in Ehrlich mouse-ascites in vitro, whereas x rays cause greater inhibition in spleen cells. Tumor cells from a retothelial sarcoma reacted similarly to both E 39 and x rays. In thymus cells no verified difference was found between treated cells and untreated controls. The combination of cystostatic agent and irradiation is by no means more effective. In spleen cells in vivo, the combination of the two is more effective if low radiation doses are used. Radiation is verifiably superior in retothelial sarcoma. Increasing the radiation dose produces a stronger radiation effect, which becomes even clearer after a five day observation period. In the spleen, the effect of the individual components cannot be increased by applying them simultaneously. (auth)

1508 THE SENSITIVITY OF THE COMPLEMENTARY COMPONENTS TO IONIZING RADIATION. Giuseppe Pontieri and Saverio Imperato (Università, Naples). Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 30: 274-81(Feb. 1961). (In Italian)

A study was made of the hemolytic activity of the four complementary components of guinea pig blood after exposure to x-radiation doses of 50,000, 100,000, 200,000, and 250,000 r. No detectable effect was observed at irradiation of 50,000 r. The results of the irradiations are shown graphically and indicate that the activity is strongly depressed by irradiations of 250,000 r. (J.S.R.)

1509 SEQUELAE TO RADICAL IRRADIATION IN CARCINOMA OF THE BREAST. AN INQUIRY INTO THE INCIDENCE OF CERTAIN RADIATION INJURIES. J. A. C. Fleming, J. F. Filbee, and G. Wiernik (St. Thomas' Hospital, London). Brit. J. Radiol., 34: 713-19(Nov. 1961).

The incidence of constitutional symptoms following radical post-operative irradiation in carcinoma of the breast is recorded. The effect of such irradiation on the skin and underlying pulmonary tissues is considered in the light of the symptoms caused and the changes found on chest x-ray examination. (auth)

1510 EFFECT OF GAMMA-RAYS UPON FOOD MICROORGANISMS. VI. STUDIES ON THE EFFECT OF GAMMA-RAYS UPON ESCH. COLI IN COMPONENTS OF VARIED METAS (ENGLISH TEXT). W. Watanabe (Tokyo Univ. of Education and Niko Co., Ltd., Japan). Bull. Agr. Chem. Soc. (Japan), 24: 673-81(1960).

Studies were made on the effects of various conditions on the survival of Esch. coli irradiated with Co^{60} gamma rays. The survival of the strain irradiated in the medium containing each of the components of various types of fish-meats and meats is reported. (Abstr. Japan Med. 1: No. 12, 1961)

1511 EFFECT OF GAMMA-RAYS UPON FOOD MICROORGANISMS. VII. STUDIES ON THE EFFECT OF GAMMA-RAYS UPON FOOD BACTERIA UNDER SOME CONDITIONS (ENGLISH TEXT). W. Watanabe (Tokyo Univ. of Education and Niko Co., Ltd., Japan). Bull. Agr. Chem. Soc. (Japan), 24: 681-4(1960).

Studies on the effects of gamma rays on a single strain of Esch. coli irradiated with Co^{60} were made. The effects of three conditions, which showed the higher survivals of Esch. coli upon other food bacteria are reported. A pure agar medium was used for irradiation beside a nutrient agar medium. (Abstr. Japan Med. 1: No. 12, 1961)

1512 RADIATION'S RAPID REACTIONS ARE ANALYZED. Can. Nuclear Technol., No. 2, 14-16; 19-20(Fall 1961).

Reaction mechanisms involved in radiation damage in living cells are reviewed. Both the direct and indirect theories of radiation damage are considered. Topics discussed include the formation and detection of free radicals, and radiation effects on macromolecules, proteins, and enzymes. (C.H.)

1513 INHIBITORY ACTION OF IRRADIATED CELLS ON THE GRAFTING OF ACTIVE CELLS IN GUERIN T8 TUMORS. Jean Jacquet, Pierre Jacob, Séverin Abbatucci, and Georges Letourneur. Compt. rend., 253: 584-6(July 17, 1961). (In French)

The effects of x radiation on the grafting of Guerin T8 tumor cells were studied. Ninety percent of the Wistar rats receiving a graft of cancerous cells developed a cancer, and the evolution of the cancer in all the rats were remarkably constant. A second series of rats were grafted with cancer cells which had received 5000 r in vitro. None of the animals developed any lesions. Homogeneous mixtures of irradiated and normal cancer cells in various proportions were also used for grafting. All the results showed an inhibitory effect by recently irradiated cells on viable cancerous cells. The frequency of the epitheliomas obtained is proportional to the relative quantity of active inoculum placed under the skin. Even when a tumor is caused, there is a small inactivation showed by a longer evolution time. (J.S.R.)

1514 INCIDENCE OF LYMPHOID LEUKEMIAS AFTER IRRADIATION OF SMALL MICE. Geores Rudali and Jean Reverdy (Fondation Curie, [Paris] and Institut du Radium, [Paris]). Compt. rend., 253: 590-2(July 17, 1961). (In French)

If 40-day old C 57 BL or (C 57 BL × AkR)F$_1$ mice are irradiated with five successive doses of 125 r at one week intervals, leukemias are provoked in 33 and 63% of the cases, respectively. If the irradiation is made from the time of birth, the leukemia frequencies are then 76 and 92%. (tr-auth)

1515 PERCENTAGE NATURAL CROSSING IN OATS PRODUCED FROM IRRADIATED SEEDS. R. L. Thurman and David Womack (Univ. of Arkansas, Fayetteville). Crop Sci., 1: 374(Sept.-Oct. 1961).

Seeds of two varieties of winter oats, Ferguson 560 and Arkwin, were exposed to 25,000 r, 20,000 r, 6 hr of neutrons, and 5 hr of neutron irradiation. A breeder line which possessed some marker characteristics was sown in rows adjacent to the irradiated seed. At maturity, the plants were harvested and threshed individually, and the seeds mixed for sowing the next generation. The plants were examined when about 8 in. high and again at maturity, and the percentage of natural crossing was measured. The percentage of natural crossing for the irradiation treatments varied. Also, the pattern for natural crossing within the varieties differed for the treatments. Possible explanations for the findings are presented. (C.H.)

1516 FREE RADICALS IN RAT TISSUES, BOTH IN NORMAL CONDITION AND AFTER IRRADIATION WITH Co^{60} γ-RAYS. I. K. Kolomiitseva, L. P. Kayushin, and A. M. Kuzin (Inst. of Biological Physics, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 230-1 (Sept. 1, 1961). (In Russian)

Wistar rats were given a 1000 r dose of Co^{60} γ rays. The rats were decapitated, and various tissues were dried for 24 hours over P_2O_5 in a vacuum-desiccator at room temperature. The dried tissue samples were pulverized in an agate mortar and subjected to an electron paramagnetic resonance analysis. Since the signals from various tissues were the same in shape and line width, comparisons of intensity could be obtained from the signal amplitude. The spleen showed the highest concentration of free radicals. The lungs, liver and suprarenals showed 1.5 to 2.0 times less free radicals than the spleen. A decrease of free radicals in the spleen could be detected five minutes after irradiation with a dose of 1000 r. No changes in the contents of free radicals could be detected in the other tissues. (TTT)

1517 THE RADIOSENSITIVITY OF VARIOUS AREAS OF THE CENTRAL NERVOUS SYSTEM DURING ONTOGENESIS. A. A. Manina (Inst. of Experimental Medicine, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 232-5(Sept. 1, 1961). (In Russian)

Female pregnant rats were given a single dose of 150 r from the 10th to the 17th day of embryogenesis. Doses of 50, 100, 200, 300, 400, 500, and 600 r were also used from time to time. Necrotic lesions of neuroblastic cells in the large hemispheres of the brain could be observed after irradiation on the 14th day of embryogenesis. The damage was more severe for irradiation on the 15th day. Two days after irradiation, reparative processes begin to take hold. After the 18th day, the damage from irradiation decreases. Thus, irradiation of embryos on the 15th to 17th day of development with doses of 150 to 300 r shows that this period is a critical one for the development of the large hemispheres of the brain. At this time, irradiation leads to extensive destruction of neuroblastic elements with subsequent impairment of structure. (TTT)

1518 THE ROLE OF WATER IN THE RADIATION "AFTER-EFFECT." L. Kh. Eidus, E. E. Ganassi, and G. K. Otarova (Inst. of Biological Physics, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 475-8(Sept. 11, 1961). (In Russian)

The necessity for the participation of water in the phenomenon of the radiation after-effect was investigated by irradiating pepsin in an acetate-buffered solution with a pH of 4.65 to 4.8, or in anhydrous glycerin with pH adjusted to 4.6 by acidifying with glacial acetic acid. The damage to the protein was determined by the decrease in proteolytic activity on hemoglobin. Damage to irradiated, dry pepsin (5 to 11 million r dose) can also be detected by thermoinactivation of the pepsin at 100 to 150°C in solution. The damaged pepsin is inactivated more rapidly than the intact pepsin in aqueous solution, but the rate of thermoinactivation is the same under anhydrous conditions. On incubating pepsin in aqueous solution at 47 to 54°C, it was found that the extent of the thermal after-effect depended only on the irradiation dose, and did not depend on the time or preliminary temperature of the irradiated pepsin. Water is a necessary component for the appearance of the thermal after-effect which is caused by radiation damage. The after-effect does not show itself in the absence of water. (TTT)

1519 POLYMER GRAFTING ON IRRADIATED WHEAT SEEDS. B. N. Tarusov and Yu. P. Kozlov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 140: 709-12(Sept. 21, 1961). (In Russian)

Winter wheat seeds (Triticum vulgare) were given a dose of 10 to 100 kiloroentgens (kr) of Co^{60} radiation in the presence of air and in the absence of air. The irradiated seeds were treated with a 0.5 to 10% aqueous solution of vinylpyrrolidone (VP) for 2 to 24 hours at temperatures of 30, 50, and 70°C. Experiments were also run on unirradiated seeds with polyvinylpyrrolidone (PVP). Maximum grafting as a result of the radiation after-effect was obtained by treating the seed in the absence of air with a 5% solution of VP after an irradiation dose of 40 kr. Grafting of PVP on unirradiated seeds also occurred. The viability of untreated seeds decreased from 80% for a 10 kr dose to 42% for a 100 kr dose. The viability of seeds treated with PVP was 87% for a 10 kr dose, and 60% for a 100 kr dose. Thus, these initial experiments show that grafting has a protective effect. The rate of growth of the shoot from irradiated seeds is at a maximum for seeds treated with a 5% VP solution for 4 hours. Cytological studies on cells of the root system of irradiated seeds treated with VP also show that the grafted polymer has a protective effect on the irradiated seeds. (TTT)

1520 SOME COMPONENTS OF ADAPTIVE VALUES OF HETEROZYGOUS DROSOPHILA WILLISTONI FROM IRRADIATED NATURAL POPULATIONS. E. K. Marques and Clara M. P. Maciel (Universidade do Rio Grande do Sul, Porto Alegre, Brazil). Experientia, 17: 404-5(1961). (In English)

The analysis of some adaptive components (percentage of hatched eggs, viability, and sterility) in an isolated natural population of Drosophila willistoni shows, after irradiation with Co^{60}, reduced adaptive values during several generations after irradiation with progressive recuperation to the control level in successive generations. However, this population for 15 generations does not attain the percentage of hatched eggs of untreated populations. (tr-auth)

1521 CHROMOSOMAL POLYMORPHISM DECREASE DUE TO γ RADIATION ON NATURAL POPULATIONS OF DROSOPHILA WILLISTONI. A. R. Cordeiro (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Experientia, 17: 405-6(1961). (In English)

In an isolated natural population of Drosophila willistoni more than 70,000 γ-irradiated flies were released within 7 months. A significant decrease of the mean inversion frequency per individual was established. Some inversions in the second chromosome and IIIC, IIID, IIIE, and IIIF were even rarer than in the nonirradiated natural control populations even 14 months (35 generations) after the last release. In the irradiated population two new inversions were found (one in the X and one in the third chromosome). (tr-auth)

1522 GENETIC EFFECTS OF γ RADIATION ON NATURAL POPULATIONS OF DROSOPHILA WILLISTONI. Helga Winge, Marly Napp, Clara M. P. Maciel, and E. K. Marques (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Experientia, 17: 406-8(1961). (In English)

An isolated natural population of Drosophila willistoni for a year supported a considerable admixture of F_1 Co^{60}-irradiated flies. The genetic analysis showed that the frequency of the lethal and semilethal alleles after 5 generations decreases rapidly to the normal. The frequency of the lethal alleles was still high. After 15 generations it decreases to the level of the natural control populations. Individual lethal alleles produced by irradiation remain in the population. (tr-auth)

1523 ACTION OF A GENERAL IRRADIATION ON WATER EXCHANGES BETWEEN THE BLOOD AND THE GASTRIC CAVITY DURING THE ABSORPTION OF GLUCOSE. M. Lourau (Institut de Biologie, Paris). Experientia, 17: 422-3(1961). (In French)

A sublethal dose of x rays, delivered to guinea-pigs 14 days before a glucose absorption test, alters the pattern of water exchange between the blood and the gastric cavity. The normal dilution, which proves to be a main factor in the regulation of the intestinal absorption of sugar, is no longer achieved. (auth)

1524 GRAFT-VERSUS-GRAFT IMMUNOLOGICAL TOLERANCE IN RADIATION CHIMAERAS. Alena Lengerova, H. S. Micklem, and Tessa Dent (M.R.C. Radiobiological Research Unit, Harwell, Berks, Eng.). Folia Biol. (Prague), 7: 309-21(1961). (In English)

In a system of two different hybrid grafts of restorative embryonic tissue given to lethally irradiated CBA mice the immune status of the established chimaeras was studied, especially regarding the concept of graft-to-graft tolerance. The results of skin grafting and tests for spleen and liver enlargement induced with chimaeric spleen cells are in agreement with the idea that under certain conditions the embryonic graft can acquire tolerance to foreign antigens met in the host environment. The rate of immunological maturation of the embryonic graft in the environment of the irradiated adult host was studied in the graft-to-graft system using a direct cytological follow-up of the fate of chromosome marked cells. The experimental results are interpreted as evidence of slower immunological maturing and therefore of a prolongation of the tolerance-responsive phase of the embryonic graft under the conditions of the experiment. The possible role of some factors of a non-immune nature which may influence the relations, between restorative cells of different origin in radiation chimeras is discussed. (auth)

1525 PRELIMINARY DATA ON RELATIVE RADIORESISTANCE OF THE APEX OF THE SHOOT AND THE ROOT APEX OF BARLEY SEEDS. Silvana Avanzi (C.N.R.N., Rome). Genet. agrar., 13: 113-22(1960). (CNEN-81). (In Italian)

Dry seeds of barley were irradiated with 3 doses of x rays and 3 doses of thermal neutrons after equilibration in an atmosphere of 60% relative humidity at 20°C. Seedling growth analysis was performed in water culture at 18 to 19°C by germinating the seeds on vertical sheets of puffed polystyrol, which allowed a very precise measurement of both shoot and root length at the eight day. For the study of chromosomal damage, the first mitotic cycle in both the shoot and the root apex was analysed. Since no statistical difference between the two classes was ascertained, the pooled data are reported in the tables. Results show that thermal neutrons are able to inhibit root growth much more strongly than shoot growth, while an almost identical degree of growth inhibition in the two organs is observed in the x-rays series. These data are in agreement with Ehrenberg and Wettstein's (1955) observations on the dry matter content of barley seedlings from seeds irradiated with x rays and fast neutrons. In order to compare the relation of chromosomal damage to growth inhibition in the shoot and in the root, for each radiation dose, an index was established by calculating the number of chromosomal breaks corresponding to a 10% inhibition. For one and the same organ, either shoot or root, the index seems to keep constant irrespective of the radiation used, the value of the shoot index being nearly four times greater than that of the root. This indicates that growth inhibition in the root is dependent on a consistently lower chromosomal damage as compared with shoot growth inhibition. At the highest doses of x rays and thermal neutrons used, a significantly greater number of chromosome breaks was observed in the shoot tips as compared with the root tip. The frequency of chromosomal breaks observed in the present experiments is clearly lower than that reported by previous investigators in irradiated barley seeds. The discrepancy might be explained by assuming a delay in mitosis initiation of cells with a higher degree of chromosomal damage. This hypothesis is being tested in a series of experiments in progress. (auth)

1526 THREE CASES OF MYELOGENIC LEUKEMIA COMPLICATED WITH MALIGNANT STRUMA SEEN IN ATOMIC BOMB SURVIVORS. Y. Fujimoto, T. Yamamoto, T. Ishida, and J. Numata (Hiroshima Hospital for Atomic Diseases). Hiroshima Igaku, 13: 636(1960).

Some statistical studies were performed on cases of leukemia complicated with cancer seen in Hiroshima during 1955 to 1958. Among the atomic bomb survivors exposed within 2 km from the center there were 1 in 1955, 2 in 1956, and 2 cases of leukemia complicated with cancer in 1957. One of the 3 cases was also complicated with bronchial cancer. However, no cases complicated with cancer were found in unexposed leukemia patients. Among the atomic bomb survivors there may be a tendency toward leukemia complicated with cancer. (Abstr. Japan Med. 1: No. 12, 1961)

1527 RADIATION INTENSITY AND THE INDUCTION OF MUTATION IN DROSOPHILA. C. E. Purdom and T. W. McSheehy (Medical Research Council, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 3: 579-86(Nov. 1961). (In English)

A study was made of the effect of intensity of irradiation on the production of IInd chromosome lethal mutations in spermatozoa and spermatogonia of Drosophila. No intensity effect was detected between x-ray doses of 3000 r given at 600 r/min and 2.0 r/min respectively, or Co^{60} γ-ray doses of 3000 r given at 2000 r/min and 2.0 r/min respectively. A comparison between the effect of Co^{60} γ rays given at 2.0 r/min and 0.01 r/min at a total dose of 200 r showed that a slight intensity effect might be operative in spermatogonia, but that this was very much less than that observed in the mouse over a comparable dose-rate range. (auth)

1528 THE EFFECTS OF X-RAYS ON THE EXTENSION GROWTH OF BARLEY ROOTS. M. Ebert (Hammersmith Hospital, London) and D. A. Barber. Intern. J. Radiation Biol., 3: 587-93(Nov. 1961). (In English)

The use of barley roots as experimental material for radiobiological investigations is described. The advantages of this material are: barley is genetically homogeneous, the plants do not require surgery, and the technique is simple both in practice and in its requirements for apparatus. 20% oxygen enhances the relative radiosensitivity of barley roots by a factor of 2.8. (auth)

1529 RELATIVE RADIATION SENSITIVITY IN THE STUDY OF THE OXYGEN SUPPLY TO ROOT MERISTEMS. M. Ebert (Hammersmith Hospital, London) and Alma Howard. Intern. J. Radiation Biol., 3: 619-25(Nov. 1961). (In English)

Experiments are reported in which the meristem of the root of Vicia faba was irradiated while the root was immersed in deoxygenated water. Oxygen was supplied in various N_2-O_2 and $He-O_2$ gas mixtures to the cotyledons of the seedlings. The relative radiosensitivity of the meristem was used as an indicator of O_2 reaching the meristematic tissue. The supply of O_2 to the lower parts of the roots is discussed. (auth)

1530 INACTIVATION OF UREASE BY X-RAYS. Sheila E. Lewis, E. D. Wills, and A. Wormall (St. Bartholomew's Hospital, London). Intern. J. Radiation Biol., 3: 647-56(Nov. 1961). (In English)

Urease, when irradiated by x rays in dilute aqueous solutions, is partially inactivated. A dose of 5000 r caused almost complete destruction of the enzyme, and 500 r caused 22% inhibition. Enzyme inactivation was small measured immediately after the irradiation, but increased gradually during a period of 2 hours after the irradiation. Protection against irradiation could be accomplished in many ways. The enzyme was self-protective, a larger concentration of enzyme reducing the inactivation with a given dose, and other proteins, such as serum albumin, were also effective. Several buffer salts protected, citrate and phosphate being most effective. Amino acids protected, but not to an equal extent, and of those tested, cysteine and methionine were found to be the most, and alanine and tryptophan the least, effective. Addition of versene and the blocking of –SH groups of the enzyme also protected. It is considered likely that the enzyme inactivation is a result of the oxidation of urease –SH groups by free radicals. (auth)

1531 INACTIVATION OF UREASE BY NITROGEN MUSTARD AND A COMPARISON WITH INACTIVATION BY X-RAYS. Sheila E. Lewis, E. D. Wills, and A. Wormall (St. Bartholomew's Hospital, London). Intern. J. Radiation Biol., 3: 657-70(Nov. 1961). (In English)

Urease is inactivated by small amounts of nitrogen mustard (Di-2-(chloroethyl) methylamine: HN2) in unbuffered solution at pH 7.0, the inhibition or inactivation being complete when 10^{-3} M nitrogen mustard is used. With 10^{-5} M solutions of HN2, 12% inhibition was observed. The inhibition is pH-dependent, the percentage inactivation with 10^{-3} M HN2 being 100 at pH 6.5 and 0 at pH 5.2. Additions of many different substances protected the urease. Buffer salts protected, citrate and phosphate being most effective; for example, urease was completely protected against inactivation by 10^{-3} M nitrogen mustard by the addition of 5×10^{-3} M, or stronger, solutions of citrate buffer. Proteins are effective protectors, but nucleic acids are not. All the amino acids tested protect, but cysteine and histidine are much more effective than most others investigated. Blocking of urease –SH groups is also an effective protective measure. The inactivation is considered likely to be a result of the combination of nitrogen mustard with histidine residues and with –SH groups of the urease. (auth)

1532 RADIOSENSITIVITY OF THE DENERVATED BONE MARROW. V. G. Kondratenko (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 3, 458-60(May-June 1961). (In Russian)

The role of the nervous system in the initiation and development of early radiation lesions of the bone marrow as revealed by the technique of luminescent microscopy is elucidated. To reveal and estimate early stages of the radiation lesion of the bone marrow, use was made of the appearance of micronecrotic foci in the irradiated bone marrow. Animals (albino rats) with denervated extremities were subjected to roentgen irradiation, and irradiated non-operated rats were used as controls. An examination of the preparations showed that foci of micronecroses are formed in practically equal numbers in the bone marrow of both operated irradiated animals and the controls. Besides these foci, numerous affected cells were noted in the preparations. It appears that the nervous system does not play a leading role in the reaction of the bone marrow of irradiated animals. This offers additional evidence to the effect that ionizing radiation acts directly upon the cell elements of the bone marrow. (auth)

1533 THE OXYGEN EFFECT IN IRRADIATION OF DORMANT BARLEY SEEDS. N. I. Nuzhdin and R. L. Dozortseva (Inst. of Genetics, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 5, 679-92(Sept.-Oct. 1961). (In Russian)

Barley seeds of two strains, viz. the Moscow and Odessa-

17, received 12,000 r of γ rays from Co^{60}. The seeds of the former strain were irradiated in air in the state of dormancy. Immediately after irradiation they were divided into three groups, and for further storage one group was transferred into N, the second in O_2, and the third one stored in air. The seeds of the Odessa-17 strain were irradiated in the dormant and resting state. Part of the seeds were irradiated in N and others in O_2. After irradiation the seeds were stored in the atmosphere of the same gases in which irradiation was performed. The radiation effect was estimated from the frequency of cells with chromosome bridges in ana- and telophase of the first mitoses in the meristeme of root tips. The effect was similar with seeds irradiated in air and then kept in N or irradiated in this gas. Anoxia greatly reduced the percent of cells with chromosome bridges no matter whether the seeds were irradiated in the dormant or resting condition. Unlike the results obtained in the N series, two kinds of result were obtained upon irradiation and storage of the irradiated seeds in O_2 or air. The percentage of cells with chromosome bridges was high both in seeds irradiated in the dormant or resting condition when dormant seeds after spontaneous or artificial release from this condition were stored, prior to germination, in oxygen or in air. In seeds irradiated in the state of dormancy, artificially released from this condition and immediately germinated, the percent of cells with bridges is similar to that of seeds irradiated in N. Hence, in seeds irradiated in the dormant state prior to release from this condition the O_2 effect is absent. This is presumably linked with reduced metabolism of these seeds. (auth)

1534 LUMINESCENCE STUDIES IN EARLY RADIATION INJURIES OF CELLS. M. N. Meisel and A. V. Gutkina (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, Moscow and Inst. of Biophysics, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 5, 693-701(Sept.-Oct. 1961). (In Russian)

Vital and supravital methods of luminescence microscopy render it possible to reveal in hemopoietic organs almost immediately after irradiation marked physico-chemical and structural injuries of the nuclei of individual cells, the number of such injured cells increasing within a few hours after irradiation. Conventional histological methods cannot reveal such early disturbances. In lymphocytes and lymphoid organs (lymphatic nodes, thymus) early nuclear disorders are of the same character as that previously described in the nuclei of bone marrow cells of irradiated animals. Radiation-injured cells of lymphoid organs are arranged in individual foci, their aggregation resembling micronecrotic foci in the bone marrow. Early nuclear lesions of cells in lymphoid organs are caused by direct action of radiation. Screening eliminates this reaction. Stratification of nuclear nucleoprotein into two fractions with a different luminescence apparently reflects the separation of DNA from protein. Early nuclear injuries are revealed also in the epithelium of the small intestine of irradiated animals. Luminescence-microscopic methods both in the visible and ultraviolet range of the spectrum are already used with success in radiobiological experiments. They are also very promising for the study of the nature of biological action of radiation. (auth)

1535 THE EFFECT OF IONIZING RADIATION UPON HEREDITY AND VITAL ACTIVITY OF SOME SORTS OF WHEAT AND RYE. V. K. Karapetyan (Inst. of Genetics, Academy of Sciences, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 5, 702-7(Sept.-Oct. 1961). (In Russian)

Hereditary changes occur as a rule in the course of metabolism, of development of the living body, and in the course of vital activity of plants cultivated under proper conditions both within the year of irradiation and in subsequent generations, but not immediately after irradiation. Seeds which have not passed the dormancy period are more resistant to high irradiation doses. This indicates the significance of metabolic processes in irradiation. Dormant seeds of different sorts of wheat and rye showed greater resistance to high radiation doses (30,000 r or more in wheat and 20,000 r or more in rye) than those released from dormancy. Hence, the mode of action of ionizing radiation depends on the physiological state of the seeds. (auth)

1536 THE EFFECTS OF X-RAYS AND BETA RAYS (TRITIUM) ON THE GROWTH OF RICKETTSIA MOOSERI AND RICKETTSIA AKARI IN EMBRYONATE EGGS. Donald Greiff, E. L. Powers, Walter E. Kisieleski, and Henry Pinkerton (Marquette Univ., Milwaukee; Argonne National Lab., Ill.; and St. Louis Univ.). J. Exptl. Med., 111: 841-9(June 1, 1960).

The growth of Rickettsia mooseri was accelerated and quantitatively increased in embryonate eggs containing tritium oxide at levels of 180, 90, and 45 mc/egg during the growth period. The eggs of a group containing 22.5 mc/egg showed only a slight increase in the rate of growth of organisms; the infections in the eggs of a group given 11.2 mc/egg did not differ significantly from those of the control group. On the other hand, growth of R. akari was inhibited in embryonate eggs containing tritium oxide at levels of 180, 90, and 45 mc/egg, and partially inhibited in groups containing 22.5 and 11.2 mc/egg. The patterns of growth of R. mooseri and of R. akari exposed to tritium oxide for 6 hours prior to inoculation into embryonate eggs did not differ significantly from that of the control group. Single and divided doses of x rays to the host resulted in partial inhibition of the growth of R. akari. (auth)

1537 STUDIES ON RADIOACTIVE CESIUM: Cs^{137}. III. HISTOLOGICAL STUDIES OF INJURIES IN SEVERAL ORGANS, ESPECIALLY THE TESTES. T. Kiyota (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi, 33: Suppl. 7, 2110-15(1959).

In the testes of mice after percutaneous administration of Cs^{137} in doses of 1.0 $\mu c/g$, a decrease in number and atrophy, pyknosis, and necrosis of spermiocytes were noted and the damage increased as time passed. A slight impairment of spermiocytes and sperms was noted even after the administration of only 0.05 $\mu c/g$. After administration of 0.1 $\mu c/g$, no pathological changes were noted in the spleen or kidney, but there were atrophy and pyknosis of the liver cells. DOCA, cortisone, or CsCl given soon after the administration of Cs^{137} had a protective effect against radiation injuries and diminished the damage to the testes. (Abstr. Japan Med., 1: No. 12, 1961)

1538 THE RESULTS OF RADIATION THERAPY SOVERING THE ORAL CAVITY ORGANS AND ACCESSORY SINUSES OF THE NOSE. A. V. Kozlova (State Scientific Research Inst. of Roentgen-Radiology Ministry of Health, RSFSR). Med. Radiol., 6: No. 10, 5-11(Oct. 1961). (In Russian)

In treating early forms of cancer of the tongue and the oral mucosa it is sufficient to employ local irradiation only, either by the radiosurgical, interstitial, or application methods, to obtain stable recovery. In these forms of the disease external radiation fails to improve the outcome of the treatment. In the therapy of cancerous metastases in the oral cavity the advantage lies with the radiosurgical method, which combines high efficiency with the minimal radiation loading on normal tissues. In treating cases with inoperable forms of cancer of the maxilla, optimal results were gained with a continuous irradiation practiced for a space of 1–3 weeks, as against fractional one, lasting 4–8 weeks. In the telegammatherapy of the cancer affecting accessory sinuses of the nose the results of the treatment not only depend upon a summary focal dose, but also on the amount of an average daily focal dose, which should not be below 220–250 r. (auth)

1539 DIAGNOSTIC SIGNIFICANCE OF CHANGE IN THE PERIPHERAL BLOOD SUBSEQUENT TO RADIATION INJURIES OF OCCUPATIONAL NATURE. D. G. Zografov (Graduate School of Medicine, Sophia, Bulgaria). Med. Radiol., 6: No. 10, 27-32(Oct. 1961). (In Russian)

Statistics are given for changes which occurred in the peripheral blood of 1178 persons engaged in a zone of ionizing radiations and 850 control individuals. The following conclusions were reached: the diagnosis of occupational radiation injuries involving hemopoiesis should be based upon the whole of the hematological syndrome; this syndrome includes hyperchromia, reticulocytopenia, leukopenia, lymphocytosis, neutropenia, monocytosis or monopenia, basophilia, and a series of morphological cellular alterations; and a longer record of service within a zone of ionizing radiations does not fully increase the probability of the fact that a pathologically changed hemogram is really a sign implying a radiation injury. (auth)

1540 THE INFLUENCE OF ANTITUBERCULOUS VACCINATION ON THE COURSE OF THE TUBERCULOUS PROCESS IN CHRONIC IRRADIATION. T. A. Khudushina (Inst. of Tuberculosis, Academy of Medical Sciences, USSR). Med. Radiol., 6: No. 10, 56-9(Oct. 1961). (In Russian)

Preliminary antituberculosis vaccination of tuberculosis-infected rabbits subjected to protracted x irradiation (10 r daily) yields a positive effect only during the first stages of irradiation. Disturbance of specific antituberculous immunity occurs in the process of development of chronic radiation sickness. At this period the tuberculous process acquires a marked exudative-necrotic character. (auth)

1541 THE INFLUENCE PRODUCED BY HIGH GAMMA-RAY DOSES ON SOME PROPERTIES OF THE VIRUSES. T. A. Bektemirov (Central Graduate Inst. of Medicine, [USSR]). Med. Radiol., 6: No. 10, 62-6(Oct. 1961). (In Russian)

The effects produced by gamma rays on infectious, hemagglutinating, and antigenic properties common to the viruses of small-pox vaccine and those of influenze (grippe) and poliomyelitis were studied. All the viruses were grown on a monostratal culture of a renal epithelium taken from semians. Complete suppression of the vital activity appeared with a dose of 15×10^5 gm for the virus of influenza, 20×10^5 for the virus of small-pox, and 40×10^5 for that of poliomyelitis. Hemagglutinins of the influenza and small-pox viruses became fully destroyed at a dose of 30×10^5 gm. The irradiation caused the antigenic properties of the viruses under study to decline. (auth)

1542 VACCINE-INDUCED ANTILEPTOSPIRAL IMMUNITY IN IRRADIATED SPOTTED SOUSLIKS. V. P. Morozova (Voronezh Inst. of Medicine, USSR). Med. Radiol., 6: No. 10, 67-9(Oct. 1961). (In Russian)

Experiments were staged on spotted sousliks treated with sublethal doses of x rays, immunized with a vaccine against Leptospirae, and then infected with them. It was made certain that there is a difference in immunity to lethal doses of Leptospirae in the rodents, depending on whether they were these doses 10 and 2 days before or after irradiation, or on the day of irradiation itself. (auth)

1543 EFFECT OF GAMMA-RAYS ON THYMUS NUCLEOPROTEIN IN SOLUTION. A. R. Peacocke and B. N. Preston. Nature, 192: 228-30(Oct. 21, 1961).

Experiments were made on the effects of gamma radiation on the molecular weight and shape of soluble desoxyribonucleohistone from calf thymus glands. The molecular weights of nucleoprotein were determined by the method of light-scattering and had an average value of 22×10^6, with a maximum variation of 10% from one independent extraction to another. Irradiation also caused a decrease in viscosity, with no after effect, and no increase in UV absorption at 259 mμ. This suggests that a decrease in molecular size occurred without denaturation of the nucleic acid of the complex. The first major effect of irradiation on the nucleoprotein complex appears to be dissociation of the small protein molecules from the nucleic acid, which remains relatively intact until most of the protein is dissociated. The effect of changes in concentration indicate that the dissociation process does not have the usual characteristics of an indirect effect. There was no evidence for denaturation of the nucleic acid in the irradiated nucleoprotein even up to 40 ev/phosphorus atom. (P.C.H.)

1544 ENHANCED EFFECT OF TOTAL-BODY X-IRRADIATION IN MICE UNDER MILD HYPOTHERMIA. H. J. G. Bloom (Royal Marsden Hospital, London and Royal Cancer Hospital, London) and K. B. Dawson. Nature, 192: 232-3(Oct. 21, 1961).

Eight-week-old albino male mice were anesthetized with intraperitoneal sodium pentobarbitone and suspended by a plastic collar in a thermostatically controlled water bath, the entire body with the exception of the head being immersed. The bath was kept at various temperatures between 29 and 37°, and the colonic temperature of each mouse was continuously recorded. The effects of whole-body irradiation with a dose of 550 r were studied, but the head, not being shielded by the water, received 12% more irradiation. The criterion of an irradiation effect was death of the animal within 30 days. The majority of fatalities occurred between the tenth and twentieth day following irradiation. The chief cause of death was found to be marrow failure. The results show an increased mortality among the animals treated under mild hypothermic conditions (31 to 35°). At a temperature of 29° a protective effect was noted. Hypothermia, by lowering the metabolic rate and by increasing the amount of oxygen dissolved in the plasma, may lead to an increase in the oxygen environment of tissues and therby perhaps an increase in radiosensitivity. (P.C.H.)

1545 EFFECT OF X RADIATION AND SCHEROSON ON TRICHOMONAS FETUS. Christo Petroff (Skin Clinic, Pleven, Bulgaria). Naturwissenschaften, 48: 533-4(1961). (In German)

A comparison was made of the effects of x radiation and scheroson on trichomonas fetuses. The irradiation dose was between 250 and 5000 r at a rate of 417 r/min. The scheroson contained hydrocortisone acetate in a water-oil emulsion. Each culture was irradiated five times and immediately after each irradiation the scheroson was added. The survival time was calculated in comparison with control samples. There was a shortening of the survival time with increasing dose. This decreased life span, a summation effect, can be caused by both physical and chemical changes induced by the irradiation. (J.S.R.)

1546 A FUNDAMENTAL STUDY ON THE EFFECT OF X-RAYS ON THE CHORIOALLANTOIC MEMBRANE OF CHICK EMBRYO. S. Matuoka. Nippon Byori Gakkai Kaishi, 48: 1509-15(1959).

The histological effect of irradiation on 11-day-old chick embryos was investigated. After receiving 800 r, all embryos died in 24 hours after the irradiation, after 700 r 50% died in 48 hours, and with 100 r all 500 embryos survived. X irradiation caused vacuolar degeneration and infiltration in the ectoderm; pyknosis, swelling, edema, and disappearance of cell projections in the mesoderm; and hyalinization in the endoderm. These pathological changes were of approximately the same degree after 10, 50, or 600 r. However, after the lower doses of irradiation, regeneration started earlier but was more gradual than that seen after large doses. Regeneration started suddenly 24 hours after irradiation with large doses and then progressed rapidly. (Abstr. Japan Med., 1: No. 12, 1961)

1547 EXPERIMENTAL RADIATION CATARACTS. II. HISTOLOGICAL STUDY OF EXPERIMENTAL ROENTGEN-RAY CATARACT. T. Tokunaga (Nagasaki Univ.). Nippon Ganka Gakkai Zasshi, 63: 1188(1959).

The rabbit's eye was irradiated with 45–2000 r (160 kv) and examined. Even with 45 r x-ray cataract was clinically or histologically observed in the eye; the changes were those of abnormal immigration of the nucleated juvenile fibers into the posterior cortex and posterior subcapsular pseudo-epithelia; small balloon cells in the posterior cortex appeared with irradiation of more than 200 r, and with irradiation of 500 r or more solitary pseudo-epithelia were observed beneath the capsule, near the posterior pole. Clinically the findings were posterior subcapsular plaque-like opacities, which always appeared in atomic bomb radiation cataract. On the rabbit's lens the opacities produced by irradiation of 600–900 r sometimes regressed slightly both clinically and histologically over a long period. In the lens with irradiation of 900 r, radioactive dysfunction was still observed in the juvenile undifferentiated fiber zone even 3 years after the irradiation. Thus a variation of x-radiation energies in the range from 80 to 160 or 180 kv (800 r) seemed to have no influence on cataractogenic effectiveness. (Abstr. Japan Med. 1: No. 12, 1961)

1548 ATOMIC-BOMB RADIATION CATARACT IN NAGASAKI. T. Tokunaga (Nagasaki Univ.). Nippon Ganka Gakkai Zasshi, 63: 1211(1959).

Radiation cataract was found in 432 (57.37%) out of 753 cases chosen from the survivors within 1800 m from the hypocenter of the explosion at Nagasaki and in 463 (45–48%) out of 1010 cases within 2400 m. The major findings were: (1) punctate opacities in the segmentation zone; (2) vacuoles in the cortex, (3) subcapsular plaque-like opacities at the posterior pole, and (4) tuft-like opacities in the cortex of the posterior pole. The changes of 1 and 4 were virtually specific findings of atomic-bomb radiation: 2 was generally always observed in other types of cataracts. 3 was also physiologically observed. The degree of severity of lenticular opacity was proportional to atomic bomb radiation dosage received. The opacities remain stationary without subsequent aggravation. (Abstr. Japan Med. 1: No. 12, 1961)

1549 STUDIES ON THE RESISTANCE TO γ-IRRADIATION OF Co^{60} IN ESCH. COLI B. T. Aoyama (Kobe Medical Coll., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 505-20(1960).

A strain of Esch. coli B, resistant to Co^{60} γ irradiation, was isolated from the original strain by means of the training method. The resistance continued to be stable on subculture for 1.5 yr. This strain survived even after exposure to 115 and 200 r, which was three times the MLD of the original strain. Morphologically, the cell size of this strain was smaller than the original as observed microscopically and by electron microscope measurement. With regard to the fermentation of sugar and the other usual biological characteristics, no difference was detected between the resistant and the original strain. (Abstr. Japan Med. 1: No. 12, 1961).

1550 METABOLIC STUDIES OF THE RAT EXPOSED TO GAMMA IRRADIATION. D. G. Baker and C. G. Hunter (Univ. of Toronto). Radiation Research, 15: 573-81(Nov. 1961).

Rats were exposed to continuous whole-body γ-irradiation for 15 days at a dose rate of 80 r per 23-hour day. During the first 10 days of exposure, the irradiated rats lost more weight, were in negative nitrogen balance, and drank less water than their pair-fed controls. By 15 days these responses were similar in the two groups and a trend toward the preirradiation values was apparent. Balance studies indicated that there was a retention of phosphorus by both the irradiated and control rats starting on the seventh day of exposure. This preceded the increase in body weight and nitrogen retention by several days. The concentration of inorganic phosphorus in the plasma remained within the normal range. The metabolic rate was depressed to approximately the same value in both the irradiated and control groups. The possibility of radioresistance was suggested. (auth)

1551 RADIATION SENSITIVITY OF OöCYTES AT DIFFERENT STAGES OF DEVELOPMENT IN THE IMMATURE MOUSE. Hannah Peters (The Finsenlaboratory, Copenhagen). Radiation Research, 15: 582-93(Nov. 1961).

The radiation sensitivity of oöcytes in the postnatal and immature mouse does not seem to be uniform but depends on the stage of development at the time of irradiation. The stages of pachytene and late diplotene are found to be highly sensitive to 20 r of x radiation, responding with immediate cell death, whereas nuclei in early diplotene and dictyotene show no immediate damage to this dose level. (auth)

1552 EFFECTS OF X-IRRADIATION ON THE ACTIVATION OF FOLIC ACID BY RAT ORGANS. J. M. Noronha and N. S. Shah (Atomic Energy Establishment, Trombay, India). Radiation Research, 15: 604-8(Nov. 1961).

The effects of 600 r of total-body x irradiation and ascorbic acid administration on the in vitro conversion of folic acid (PGA) to citrovorum factor (CF) by rat organs were studied. The metabolism of PGA remains unimpaired in the liver. There is some reduction of the endogenous levels of CF in the spleen and a marked lowering of the activating mechanism in the irradiated bone marrow. This impairment results from a decreased cell population as well as from the destruction of tissue ascorbic acid. The latter was corrected by ascorbic acid administered intraperitoneally 100 minutes after irradiation or added to the in vitro system. (auth)

1553 LECITHINASE AND LYSOLECITHINASE ACTIVITY OF RAT INTESTINAL MUCOSA AFTER WHOLE-BODY X-IRRADIATION. Athos Ottolenghi and Frederick Bernheim (Duke Univ., Durham, N. C.). Radiation Research, 15: 609-15(Nov. 1961).

Twenty-four hours after whole-body x irradiation the lecithinase activity of rat intestinal mucosa has markedly decreased and the lysolecithinase activity has decreased to a lesser extent. Addition of normal mucosa or chymotrypsin to the irradiated mucosa restores the activity of both enzymes. This indicates that irradiation either produces an inhibitor or inactivates a mechanism necessary to convert pro-enzymes into active enzymes. Since chymotrypsin can increase to some extent the activity of the enzymes in normal mucosa, the second possibility seems more probable. (auth)

1554 THE X-RAY SENSITIVITY OF ESCHERICHIA COLI IN THE PRESENCE OF β-MERCAPTOETHYLAMINE. Cezar A. Elias (Oak Ridge National Lab., Tenn.). Radiation Research, 15: 632-40(Nov. 1961).

β-Mercaptoethylamine (MEA) lowers the sensitivity of E. coli to x irradiation. The effect is greater than the effect of oxygen removal by nitrogen treatment. It is larger for cells suspended in 0.85% NaCl than for those in 0.066 M phosphate buffer. The degree of protection depends on the pH of the suspension, the effect being greater at pH 7 than at pH 6. MEA treatment yields the same surviving fraction whether or not oxygen is present in the cell suspension at the time of addition of the compound. (auth)

1555 CHANGES IN BRAIN EXCITABILITY AFTER WHOLE-BODY X-IRRADIATION IN THE RAT. Fred Rosenthan and Paola S. Timiras (Univ. of California, Berkeley). Radiation Research, 15; 648-57(Nov. 1961).

A single exposure to 500 r of whole-body x irradiation produced prolonged changes in threshold and pattern of electroshock convulsions in rats. Irradiated animals had lower electroshock seizure thresholds, shorter maximal seizures, and longer periods of postictal depression than controls. When their body weight was kept at the reduced levels characteristic of irradiated rats, pair-fed rats did not show these changes in threshold and pattern of electroshock seizures. Statistically significant differences between irradiated and nonirradiated rats in responses to electroshock convulsions were observed within the first 10 postirradiation days, and these irradiation effects persisted for the duration of the experiment, i.e., 180 days. These data are tentatively interpreted to indicate that whole-body irradiation produces a state of brain hyperexcitability and decreases the ability for sustained heightened nervous activity. (auth)

1556 INABILITY OF X-RAYS TO ALTER THE PERMEABILITY OF MITOCHONDRIA. J. F. Scaife and P. Alexander (Defence Research Chemical Labs., Ottawa). Radiation Research, 15: 658-74(Nov. 1961).

Mitochondrial permeability was estimated enzymatically by the spectrophotometric estimation of the rate of formation of DPNH from exogenously added DPN, and manometrically with phenazine methosulfate, by intramitochondrial dehydrogenases. By using these techniques it was found that suspensions of mitochondria in 0.25 M sucrose showed no alteration of their permeability toward DPN or phenazine methosulfate after doses of x irradiation of 9000 rads, either immediately after irradiation or after incubation at 25°C for 15 minutes. Mitochondria isolated up to 4 hr subsequent to whole-body x irradiation with 1000 rads likewise showed no alterations to their permeabilities. The enzyme activities of the dehydrogenases tested were not altered after irradiation. The osmotic swelling and the rates of nonosmotic swelling of mitochondria induced by phosphate, calcium, or thyroxine were also unaffected after in vitro irradiation. Mitochondria from liver, kidney, spleen, and thymus of a variety of mammalian species were investigated. (auth)

1557 LETHAL DOSE STUDIES WITH CATTLE EXPOSED TO WHOLE-BODY Co^{60} GAMMA RADIATION. Daniel G. Brown, Ralph E. Thomas, Larry P. Jones, Fannie H. Cross, and Daniel P. Sasmore (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiation Research, 15: 675-83(Nov. 1961).

Sixty adult grade Hereford cattle were exposed in six groups to whole-body Co^{60} γ radiation at doses of 450 to 700 r. The LD$_{50(30)}$ was 543 r with a 95% confidence interval of 518 to 567 r. The estimated LD$_{50(30)}$ dose at the mid-line was 160 r. The mean survival time was 20.3 days. All deaths were associated with depression of the hematopoietic tissue and infection. The clinical syndrome was characterized by depression, generalized weakness, diarrhea, dyspnea, and hemorrhage. The hematological changes were comparable to those reported for calves and other large animals. (auth)

1558 THE DEPENDENCE OF RBE ON ENERGY OF FAST NEUTRONS. 2. BIOLOGICAL EVALUATION AT DISCRETE NEUTRON ENERGIES IN THE RANGE 0.43 TO 1.80 MEV. J. L. Bateman, H. H. Rossi, V. P. Bond, and J. Gilmartin (Brookhaven National Lab., Upton, N. Y.). Radiation Research, 15: 694-706(Nov. 1961). (BNL-5339)

A total of 760 mice was employed in exposures at five different energy levels of monoenergetic neutrons, ranging from 0.43 to 1.80 Mev, obtained from a tritium target bombarded with protons from an accelerator. Four-day spleen and thymus weight loss were plotted against dose by expressing neutron- and x-irradiated organ weights as per cent of stress organ weights. ED$_{50}$ ratios subsequently yielded an RBE value for spleen of 5.1 at 0.43 Mev, declining to 3.5 at 1.80 Mev. Thymus values of RBE at the same neutron energies were 4.4 and 3.3, respectively. The relationship of RBE to LET and to the results of other studies is discussed, as is the effect of dose rate on the values obtained. (auth)

1559 DOSIMETRY FOR A TOTAL-BODY IRRADIATION CHAMBER. Melville L. Jacobs and Leon Pape (City of Hope Medical Center, Duarte, Calif.). Radiology, 77: 788-92(Nov. 1961).

Design features and dosimetry are reported of a human whole-body irradiation chamber employing 8 Cs^{137} sources with an initial strength of 300 curies each. When in treatment position, the sources are housed in 4 upright posts located in the corners of the treatment area. Each treatment portal has a removable beam-absorber holder to which a wide variety of absorbers and beam shaping blocks can be secured. Dosimetry measurements were made with the aid of a full-size mannequin constructed of Fiberglas, with Lucite tubes inserted at suitable intervals to provide channels for the dosimetry throughout the extent of the phantom. Measurements were carried out with a Victoreen condenser-r meter and multiple small Landsverk thimble chambers, calibrated for energy dependence. A floor plan, photograph, and cross-section of the irradiation unit and isodose patterns for various absorbers are presented. It is pointed out that in whole-body irradiation, the organ dose and, therefore the integral dose in a given volume must be considered as an indicator of dose rather than point dose. (C.H.)

1560 INTERSTITIAL IRRADIATION OF BRAIN TUMORS WITH IRIDIUM 192. Norman E. Chase, Harold L. Atkins, and James W. Correll (Columbia-Presbyterian Medical Center, New York). Radiology, 77: 842-3(Nov. 1961).

A procedure is described for the interstitial irradiation of brain tumors with sources consisting of Ir^{192} seeds encased in steel placed at 1-cm intervals along a nylon ribbon. The ribbons are implanted at craniotomy after surgical decompression of the tumor. Dose rate is calculated from measurements of source distribution on postoperative radiographs and a tumor dose of 5,000 to 7,000 r in 4 to 7 days is administered before removal of the implant by gently withdrawing the ribbon. Initial appraisal of several patients who received this form of therapy was encouraging. (C.H.)

1561 GONADAL EXPOSURE DOSE DURING DIAGNOSTIC X-RAY PROCEDURES. Ferdo Petrovčić and Bianka Benković (General Hospital, Zagreb). Radovi med. fak. Zagrebu, 8: 188-94(1960). (In Yugoslavian)

Hazards from gonadal exposure during diagnostic x-ray examination of both sexes are discussed. It is pointed out that gonadal exposure may be reduced by the use of proper techniques. (C.H.)

1562 EFFECTS OF ADRENOCORTICAL HORMONE ON OCULAR DAMAGE PRODUCED BY β-IRRADIATION FROM Sr^{90}. Y. Uemura (Keio Univ., Tokyo). Rinsho Ganka, 12: 1219(1958).

The development of corneal damage could not be prevented even when steroid hormone was administered immediately after β irradiation, although it decreased the degree of damage to the cornea and iris, and shortened the course in comparison with the non-treated eye. Vacularization was markedly inhibited in the cases subjected to irradiation not greatly exceeding the MLD dose. Severe changes such as ulceration or perforation which were observed in the non-treated eye were prevented even after an irradiation of 63000 rad. No significant difference was found between the effectiveness of cortisone, hydrocortisone, and prednisolone. (Abstr. Japan Med. 1: No. 12, 1961)

1563 ELECTRON MICROSCOPIC STUDIES ON KELOID FOLLOWING ATOMIC BOMB INJURIES. C. Tamagawa and T. Oda (Hiroshima Univ.). Saihokaku Kagakukyokai Simposia, 9: 253(1959).

Keloid following atomic injuries, idiopathic keloid, postoperative scar keloid, irradiated skin, and normal skin were examined electron microscopically. Keloid following atomic bomb injuries consisted of atypical proliferation of fibroblasts originating from capillary adventitial cells in the cutis. Hydropic degeneration of epidermal cells, which appeared frequently in this keloid, was considered to be perinuclear. (Abstr. Japan Med. 1: No. 12, 1961).

1564 LIFE SHORTENING AND PRODUCTION OF TUMORS BY STRONTIUM-90. Miriam Finkel (Argonne National Lab., Ill.). Science, 132: 1683-4(Dec. 2, 1960).

Factors are discussed which must be considered in the statistical analysis of data on life-shortening and the production of tumors by strontium-90. It is pointed out that there is no question but that a correction for the time during which the radiation dose accumulates is required for a complete evaluation of the long-term toxicity of any internal emitter. However, with the present state of knowledge, we do not know over what period of time the dose should be integrated. A major problem concerns the length of the latent period between injection and neoplastic change since any radiation received after a tumor has been induced is wasted as far as that tumor is concerned. Another problem concerns the relative contributions of dose-rate and total accumulated dose to the response, whether it be tumor induction, life shortening, or any other effect. (C.H.)

1565 COMPARISON OF RBE BETWEEN Co^{60} γ-RAY AND X-RAY. I-IV. K. Urata, S. Urata, T. Yoshikawa, and T. Nozaki (Tokushima Univ., Japan). Shikoku Igaku Zasshi, 16: 171-216(1960).

A comparison of the relative biological effectiveness (RBE of Co^{60} γ ray with x ray was made in animal experiments. When dd strain mice were exposed to single whole-body irradiation, the RBE of Co^{60} γ ray was estimated to be about 0.85. However, since the RBE of Co^{60} γ ray was found to be nearly 1 in the radiosensitive organs, the therapy dose of Co^{60} γ ray was considered to be equivalent to an x-ray dose. On the other hand, a comparison of loss of weight in the thymus, spleen, testes, and intestine made after irradiation of Co^{60} γ ray and x ray resulted in a RBE of 0.8 to 1.0. When the body weight was measured, similar results were obtained. However, no significant difference was found in the RBE of the two types of radiation when delay of the cleavage in the Echinoidea was used as an indicator. (Abstr. Japan Med. 1: No. 12, 1961)

1566 STUDY ON RADIATION EFFECTS ON CELLS. III. ELECTRON MICROSCOPE EXAMINATION OF RADIATION EFFECT ON TUMOR CELLS. H. Morimoto (Tokushima Univ., Japan). Shikoku Igaku Zasshi, 16: 390-5 (1960).

Morphologic changes of MTK ascites tumor after x irradiation in vivo and in vitro were studied by the electron microscope. Immediately after in vivo irradiation, swelling of mitochondria, aberration of crista mitochondriales, and decrease of density of mitochondrial matrix were seen. They recovered, however, after several hours. The endoplasmic reticulum was imaged clearly just after irradiation of 200 r and was the most marked when 1000 r was given. After in vitro irradiation, changes similar to those observed in vivo were seen, though very little recovery occurred. It was concluded that one of the mechanisms of the action of radiation on tumor cells consisted of direct injury to cell structures such as the destruction of mitochondria or endoplasmic reticulum. (Abstr. Japan Med., 1: No. 12, 1961)

1567 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. XLI. MODIFICATION OF SERUM ALBUMIN BY X-RADIATION IN VITRO. Ruprecht Koch and Dieter Klemm (Universität, Freiburg i. B.). Strahlentherapie, 115: 586-92(Aug. 1961). (In German)

The x-irradiation (50 kV, 25 mamp) of watery albumin solutions (pH 7.0) leads to a decrease of the protein concentration proportional to the dose. In examinations with the ultracentrifuge after 6×10^6 r and with the paper electrophoresis after 5×10^6 r practically no more albumins are provable. This radiation effect is protected by the addition of cystein. A change in the speed of sedimentation and the diffusion is not observable after doses of up to 6×10^6 r. The appearance of lighter or heavier components after radiation with doses between 0.5×10^6 r could not be proved in the ultracentrifugal diagram, i.e., the molecular weight of the albumins does not change. A precipitation or coagulation can be excluded. The share of the normally provable dimers in the crystalline albumin with the sedimentation coefficient $s_{20} = 6.55$ s does not change either with radiation or through the addition of cystein to the solution. A dose-dependent decrease, above all of the albumin share, is electrophoretically observed after x-ray radiation of cattle serum. In the dose range of 5×10^6 r the albumin fraction is no longer provable. (auth)

1568 ANIMAL EXPERIMENTAL, HISTOLOGICAL, AND DOSIMETRIC INVESTIGATIONS ON SIMPLE RADIOBIOLOGICAL MODELS AND THEIR PRACTICAL APPLICATION. III. THE PHOSPHORUS-32 TRANSPORT VELOCITY FROM THE SKIN OF GUINEA PIGS. Ludwig Rausch (Universität, Marburg, Ger.). Strahlentherapie, 115: 593-8(Aug. 1961). (In German)

The third model used in experimental animal work on sieve and grid irradiation, the measurement of P^{32} transport speed from intracutaneous weals on guinea pigs skin, is briefly discussed by means of the already existing and related work. Besides indications upon the applicability of the model the limits of valid conclusions are mentioned by means of an example, in which the reaction of homogeneously irradiated, sieve-irradiated, and non irradiated areas, compared by means of the weal resorption time, the fluorescence time, and the P^{32} transport speed were tested. (auth)

1569 THE EFFECT OF EXOGENIC AND ENDOGENIC FACTORS ON THE RADIATION REACTION OF THE SKIN. III. HISTOCHEMICAL INVESTIGATIONS ON THE EFFECT OF EXTERNA ON THE RADIATION REACTION OF THE SKIN. Karl Heinz Kaercher (Universität, Heidelberg, Ger.). Strahlentherapie, 115: 599-608 (Aug. 1961). (In German)

Attention is drawn to the system and the possibilities of the combined staining of neutral and acidic mucopolysaccharides with Alcian-blue PAS reaction. The changes on the radiated and locally treated rabbit skin with this reaction are followed up. It can be shown, that in the local treatment with powder and salves no essential differences in the turning out of the Alcian-blue PAS reaction are provable. By using a hydrocortisone-serol-salve, however, there is a clear protective action on epidermis and connective tissue with a rich content of neutral and acidic mucopolysaccharides. (auth)

1570 THE BIOLOGICAL VALUE OF MAMMALIAN ERYTHROCYTES AFTER THE EFFECT OF HIGH X RADIATION DOSES IN VITRO. Vladimir Sebestik, Jaromir Jelinek, and Zdenek Dienstbier (Charles Univ., Prague). Strahlentherapie, 115: 609-21 (Aug. 1961). (In German)

The biological value of mammal erythrocytes (dog and rabbit), which were exposed, in vitro, to radiation with x rays in doses from 40,000 and 60,000 r (200 kv, 15 mamp, 0.5 mm Cu = 1 mm Al, focal distance 16.5 cm) was determined. The radiation action was valued in the following fashion: To a normal, non-irradiated receiver the blood was replaced with radiated blood by means of an exchange transfusion; the survival time of the radiated erythrocytes in the organism was further examined by means of radiochrome Cr^{51}. The exchange transfusions of the blood radiated with 60,000 r were well received by a 75% replacement of the receiver erythrocytes through radiated erthrocytes. Neither before nor after the transfusion was a sign of massive hemolysis observed. Also the survival time of the erythrocytes radiated with 40,000 r was not significantly influenced. The tests showed that radiated erythrocytes retain, essentially, their biological value. (auth)

1571 EFFECTS OF IONIZING RADIATIONS ON SEEDS. Proceedings of the Symposium on the Effects of Ionizing Radiations on Seeds and Their Significance for Crop Improvement, held at Karlsruhe, 8-12 August 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. 1961. 663p. (STI/PUB/13). $9.50.

Fifty-one papers are included; four in French and 47 in English. However, English abstracts are included for each paper. Abstracts have been prepared for 48 papers; one paper on anatomy of seeds was not abstracted and two papers were previously abstracted in NSA. (P.C.H.)

1572 SEEDLING HEIGHT, OXYGEN AVAILABILITY, STORAGE AND TEMPERATURE: THEIR RELATION TO RADIATION-INDUCED GENETIC AND SEEDLING INJURY IN BARLEY. Richard S. Caldecott (Univ. of Minnesota, St. Paul). p.3-24 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Dormant barley seeds with an embryo water content of 4% are ideal test material for biophysical studies concerned with the influence of pre- and post-radiation treatment conditions on the manifestation of genetic injury. In the course of investigations designed to examine some of the environmental parameters that are known to affect radiosensitivity, the following observations were made: The interchange frequency increases exponentially with dose when seeds are hydrated acrobically immediately after x radiation, but linearly with dose when they are hydrated anaerobically. For both conditions of hydration the mutation frequency increases linearly with dose. However, aerobic hydration results in the production of more mutations per roentgen than does anacrobic hydration. Seeds germinated immediately after x radiation and then grown for eight days show a normal distribution of seedling height about the mean. However, if seeds are stored at room temperature before germination, the distribution of seedling height about the mean becomes progressively skewed, as a function of storage time, for a period of at least eight days. Determination of the extent of genetic injury in different seedling height classes in material that was stored for eight days showed that there was an inverse relationship between seedling height and genetic injury. On the average, seeds that fell into the shortest height class evidenced between 10 and 15 times as many interchanges and mutations as seeds that fell into the tallest height class. Pre- and post-irradiation heat treatment modified the extent of injury that seeds evidence from a given dose of x rays. The post-radiation picture is not yet clear. However, pre-treatments of 75°C during a period of twenty-four hours protected seeds from a wide range of doses of x rays. The protective effect of the treatment was manifest when the seeds were hydrated either aerobically or anaerobically and was not associated with a detectable change in water content. Furthermore, the percentage of protection obtained, per unit of injury, under both conditions of hydration was similar. In connection with these studies, it was also demonstrated that the protective effect of the heat treatment against a subsequent dose of x rays persists for at least two months between heating and irradiation providing the humidity of the storage atmosphere is not changed. (auth)

1573 THE EMBRYO TRANSPLANTATION TECHNIQUE IN THE STUDY OF EMBRYO-ENDOSPERM RELATIONS IN IRRADIATED SEEDS. P. Meletti and F. D'Amato (Università, Cagliari, Italy; Università, Pisa, Italy; and C.N.R.N., Rome). p.47-55 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Seeds of Bonus barley and Albimonte wheat, irradiated with high doses of x rays, thermal neutrons, and gamma rays, were used in embryo transplantation experiments in both directions [irradiated embryo on unirradiated endosperm, EM (i)/EN (u), and unirradiated embryo on irradiated endosperm, EM (u)/EN (i)]. Intact seeds as well as homotransplants (unirradiated embryo on unirradiated endosperm) served as controls. In a first series of experiments with barley (x-ray doses of 50, 100, 200, and 400 kr), the most common transplantation technique was used, which leaves some residual endosperm attached to the embryo to be transplanted (technique A). No clear effect of the irradiated endosperm on the unirradiated embryo was observed, either on seedling growth or on plant survival in the field. On the contrary, in a total of 2400 irradiated embryos (600 for each x-ray dose) grafted on unirradiated endosperm, 33 mature plants were obtained (no survival from the control seeds irradiated with the same x-ray doses). A genetical test in the following generations did not reveal any seedling mutation, either in the EM (i)/EN (u) or in the EM (u)/EN (i) plants. Possible explanations for these results are presented. In another series of experiments on barley with a more refined technique, allowing the transplantation of completely endosperm-free embryos (B), it has been found that: x irradiated endosperm tends to reduce both shoot and root growth of EM (u)/EN (i) seedlings; with thermal-neutron-irradiated endosperm, growth depression is observed only in the root system of the embryo grafted on it. Using technique B on Albimonte wheat, it was also shown that heavily gamma irradiated endosperm depresses growth in both the root and the shoot system of the embryo transplanted on it (doses of 250, 500, and 1000 kr were used). A strong reduction in field survival also occurred for unirradiated embryos transplanted on endosperms irradiated with 1000 kr of gamma rays. It was concluded that the embryo transplantation technique, if suitably refined, may prove useful in studying embryo-endosperm relations in irradiated seeds. (auth)

1574 PRODUCTION AND DECAY OF FREE RADICALS INDUCED BY X-IRRADIATION OF DRY LETTUCE SEEDS. Malcolm L. Randolph and Alan H. Haber (Oak Ridge National Lab., Tenn.). p.57-65 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961.

Electron spin resonance (ESR) studies on free radicals produced by x irradiation of lettuce seeds show that: about 310 ev is dissipated in the seeds per long-lived, moderately narrow (less than 50-oersted-wide) resonance formed; by far the greater portion of the resonances are formed in the embryo rather than in the fruit coat or seed coat; the resonance patterns have no pronounced fine structure; there is probably a saturation limit to resonances produced per gram of whole seed; there is a very broad resonance produced in the fruit coat; and decay of number of resonances (N) may be considered as multiexponential with time (t) or expressed as $N(t) = N(1) - \beta \log t$. Since germination determinations are possible at the minimum dose required for ESR measurements, results of preliminary attempts to correlate radical concentrations and germination after various treatments and, in particular, the protective compound AET-Br are discussed. (auth)

1575 RADIATION DAMAGE IN VICIA FABA SEEDS. Walter Klingmueller (Universität, Giessen, Ger.). p.67-73 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Experiments on the seeds of Vicia faba minor show that at present it is early to make generalizations in this report. Vicia shows the same marked increase in radiation sensitivity if the seeds are dried to low moisture content before irradiation, but the ultimate damage, as measured by decrease in germination percentage and root and shoot growth reduction in the seedlings, shows no dependence on storage time after irradiation up to 8 weeks, nor on oxygen availability during soaking. The situation is complicated by the harmful effect of drying on Vicia faba minor seeds. Certain peculiarities in the ESR-absorption spectra are discussed which suggest that there is no definite correlation between radiation damage and free radical content of the irradiated seeds. (auth)

1576 GAMMA RADIATION AND INTERSPECIFIC INCOMPATIBILITY IN PLANTS. D. Roy Davies and E. T. Wall (Wantage Research Lab., Berks, Eng.). p.83-101 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

A series of attempts was made to exploit the destructive properties of ionizing radiations in overcoming the barriers to hybridization that exist between many closely related species of plants. One series in particular within the genus Brassica was successful in that many interspecific hybrids were produced after irradiation of either male or female gametes. This and other results are discussed in relation to the possibility of utilizing this technique in programs of crop improvement. (auth)

1577 THE EFFECTS OF IRRADIATION IN RELATION TO THE BIOLOGICAL TRAITS OF THE SEED IRRADIATED. M. Sarić (Inst. for Agricultural Research, Novi Sad, Yugoslavia). p.103-16 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The effects of irradiation depend on the biological traits of the seed irradiated. This has been determined on the basis of a series of changes both in the seed and in the plant grown from irradiated seed and consists of cytological, morphophysiological, and biochemical changes in the object irradiated. The radiosensitivity of the seed differs according to its ontogenetic development (physiological state), that is, according to its degree of maturity. Ontogenetically younger seed is much more radiosensitive than ontogenetically-older seed. Polyploid forms obtained artifically are more radioresistant than the original form having a smaller number of chromosomes. However, in the case of natural polyploids the number of chromosomes is not the decisive factor of radioresistance. Hybrid forms are considerably more radioresistant than their parents. This phenomenon is another proof that hybrid forms have more vitality than their parents. The resistance to irradiation is conditioned by the biological traits of the representative of the lowest botanic category, that is, the variety. Every variety has its specific radioresistance. (auth)

1578 STUDIES ON DIPLONTIC SELECTION AFTER X-IRRADIATION OF BARLEY SEEDS. Horst Gaul (Max-Planck-Institut für Züchtungsforschung, Cologne). p.117-38 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Dry seeds were irradiated with three doses, 10,000, 20,000, and 30,000 r. Thereafter, each treatment was divided into three lots. Two lots were sown directly into the field, one extremely closely spaced and the other widely spaced, which lead to great differences in tillering. The third lot was raised in the greenhouse and later transplanted, closely spaced, into the field. During the first weeks of growth the tillers of each M_1 plant were marked according to the sequence in which they were thought to have appeared. In the lot sown in the field (widely spaced) the first 14 tillers could be labelled and the rest were pooled into spike group 15. It was found that both the frequency of chromosome mutations (in terms of M_1 sterility) and the frequency of M_2 chlorophyll mutations decrease significantly the later the tillers form. This result is in accordance with a working hypothesis on diplontic selection which was advanced recently on the basis of preliminary results. Furthermore, using the method of the segregation frequency of mutants in mutated M_1 spike progenics, it could be shown that the average size of mutated spike sectors increases with increasing dose as well as in the later-formed tillers. For example, for a given dose, the mean size of mutated sectors in the first two tillers may comprise about 50% of the florets of a single spike, whereas in the later-formed tillers nearly 100% are involved and the chimera often includes several spikes. This means that in this case, each of the first two spikes (generative tissue) is, on the average, derived from about two (surviving) initial cells of the irradiated embryo, whereas the later-formed spikes are originated by only one. Among other results reported, an increase of the mutation frequency was observed which was significantly greater than the power 1 of the dose. (auth)

1579 THE OXYGEN EFFECT IN BARLEY SEEDS. R. A. Nilan, C. F. Konzak, R. R. Legault, and J. R. Harle (Washington State Univ., Pullman). p.139-54 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Depending upon such factors as temperature and moisture the oxygen effect can be enhanced or limited. In very dry barley seeds the response to oxygen can be maintained for extended periods. In moist seeds an oxygen effect can be demonstrated during but not after irradiation. Presoaked and dried seeds show an enhanced oxygen effect compared with non-soaked seeds at the same moisture level. The uniformity response of seeds exposed to neutrons can be simulated in dry seeds exposed to oxygen-saturated water after gamma radiation. Without this treatment a variable seedling height response is observed. A comparison of seedling injury, chromosome aberrations, and mutations suggest that oxygen enhances the radiation response by a factor of 5 to 8 depending upon the criteria of damage. These data appear to be consistent with evidence on the induction of magnetic centers by radiation. (auth)

1580 MODIFICATION OF INDUCED GENETIC DAMAGE IN SEEDS. C. F. Konzak, R. A. Nilan, R. R. Legault, and R. E. Heiner (Washington State Univ., Pullman). p.155-69 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Induced chromosome aberrations under some conditions may be correlated with genetic mutations, seedling injury, and other measured effects of radiation and other mutagens. The studies clearly demonstrated both with radiation and a chemical mutagen that, while sometimes associated, the several effects measured are not necessarily related. Barley seeds, exposed to gamma radiation at −78°C, then given a one-minute shock treatment in +60°C water showed higher survival, fewer chromosome aberrations, and a higher ratio of mutations to aberrations than similarly irradiated non-shocked seeds. Seeds differing in moisture appear to respond differently, but a protection effect was observed for both high and low moisture seeds. Treatments of barley seeds with a solution made from diethyl sulfate induced a higher frequency of mutations than radiation, but few gross chromosome aberrations. Survival of the treated seeds was also greater than that for radiation-exposed seeds at the same level of seedling injury. (auth)

1581 POST-IRRADIATION STORAGE AND THE GROWTH OF BARLEY SEEDLINGS. Sheldon Wolff and A. M. Sicard (Oak Ridge National Lab., Tenn.). p.171-9 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

If irradiated Himalaya barley seeds are stored for varying periods up to 32 days before germination, then the radiation damage as measured by seedling height (maximum height of the first leaf) will vary according to the moisture content of the seed both at the time of irradiation and during storage. Seeds of normal dryness (10% H_2O) do not change when stored under normal conditions. These seeds grow taller than desiccated seeds (2% H_2O), which also do not change if stored in a calcium chloride desiccator. However, if irradiated seeds of normal dryness are stored in a desiccator before germination, radioinduced damage increases in the post-irradiation period. Conversely, desiccated seeds show a post-irradiation recovery if stored under conditions of normal moisture. These changes in seedling height are not correlated with radioinduced chromosomal damage measured in the first root-tip division of the germinating seeds. The pattern of damage can be correlated to the behavior under similar régimes of long-lived radioinduced radicals. Similarly, post-irradiation heat-shocks that can inhibit both radioinduced damage and radical life times in bacterial spores were found to simulate the effects on desiccated seeds of storage under moist conditions. (auth)

1582 NON-PHOTOSYNTHETIC CONTROL OF GROWTH AND MORPHOGENESIS OF SEEDLINGS BY VISIBLE RADIATION. Hans Mohr (Universität, Freiburg i. B.). p.181-8 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

During recent years it was demonstrated that in the case of white-seeded mustard (Sinapis alba L.) the photomorphogenesis of the young seedling is controlled by two photoreactive systems. One system is the well-known reversible red, far-red photoreactive system, the other is the so-called blue, far-red photoreactive system (this latter term is derived from the double peak action spectrum with peaks at approximately 450 and 725 mμ). These two systems not only differ in their action spectra but also differ greatly in their energy requirement, that is, in the amount of effective quanta which must be given to the plant to induce a measurable physiological response. Regarding necessary energy, the reversible red, far-red system is called the low-energy reaction and the blue, far-red system, a high-energy reaction. In the case of Sinapis alba L., both systems function in a synergistic manner, that is, the same type of photoresponse can be induced with both systems. However, in the case of lettuce seedlings (Lactuca sativa L.), certain photoresponses were found to be the result of an antagonistic function of the two systems. According to present knowledge it seems that photomorphogenesis of dicotyledonous seedlings is controlled by these two photoreactive systems. Apparently whether there is a synergism or an antagonism of the two systems with respect to the final photoresponse depends on the species of plant. (auth)

1583 PHOSPHORYLATION AND RED-SPECTRUM PHOTOMORPHOGENESIS. S. A. Gordon and K. Surrey (Argonne National Lab., Ill.). p.189-96 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The phosphorylative capacity of both animal and plant mitochondria were found responsive to the red spectral region. Narrow bands in the near-red (650 mμ) and far-red (725 mμ) from a high-energy spectrograph were used. Esterification of ADP to ATP by rat-liver mitochondria was decreased by concomitant or prior irradiation with far-red and increased by near-red light. The effect of one spectral region was reversible by the other in an alternating sequence. Irradiation of young Avena seedlings altered the phosphorylative capacity of the mitochondria subsequently isolated; each spectral band either enhanced or impaired esterification, depending upon when irradiation took place in the germinative period. A more obvious correlation of the phosphorylation with morphological response to the near-red and far-red was shown by Grand Rapids lettuce seed. Here both germination and conversion of inorganic to organic phosphate compounds responded similarly to the near-red and far-red, and showed similar patterns of reversibility. The photosensitivity of ATP formation is considered as a biochemical basis for the far-red potentiation of x-ray-induced chromatid aberrations. It is also suggested as a metabolic determinant of red-spectrum photomorphogenesis. (auth)

1584 THE EFFECT OF X-RAY IRRADIATION IN CONJUNCTION WITH RED AND FAR-RED LIGHT ON LETTUCE SEED GERMINATION. Gabriel Stein and Richard Richter (Hebrew Univ., Jerusalem). p.197-9 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The effects of x rays on lettuce seeds were investigated at 26°C, where the germination of the seeds shows reversible photosensitivity to red, far-red light. It was found that low doses of x rays promote germination (with a maximum at about 1 r) while higher doses (of the order of 10^3 r) show the usual inhibitory effect. The action of the low doses appears to be connected with the light sensitive mechanism. The effect of the large doses was found to be reversible to some extent by white light, and it appears that the green component is responsible. (auth)

1585 X-RAY- AND NEUTRON-INDUCED MEIOTIC IRREGULARITIES IN PLANTS WITH SPECIAL REFERENCE TO *ARACHIS HYPOGOEA* AND *PALNTAGO OVATA*. K. C. Bora, S. H. Patil, and K. C. Subbaiah (Atomic Energy Establishment, Trombay, India). p.203-16 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Plants raised from seeds of *Arachis hypogoea* var. Spanish improved (2n = 40) irradiated with 250-kv x-ray doses ranging from 25 to 75 kr were analyzed for meiotic irregularities. The abnormalities observed include irregular development of the spindles and their activity, abnormal association of chromosomes and their separation at anaphase, occurrence of bridges and fragments, failure of cytokinesis, formation of polyads, and anomalies in the development of pollen grains. The effect on the development of the spindle presents some remarkable features in that cells were observed not only with a multiplicity of independent spindles but varying number of interconnecting spindles (up to six) around four common polar groups of chromosomes. Based on the unusual configuration observed, an attempt was made to postulate a possible mechanism of polyspindle formation. Analysis of meiotic cells of *Plantago ovata* (2n = 8) of 1×10^{12} pn/cm^2, 2.5×10^{12} pn/cm^2, and 5×10^{12} pn/cm^2 revealed rings and chains of four chromosomes, almost all leading to adjacent types of segregation and plants with abnormal microsporogenesis resulting in the formation of monads to octads. Although about 18% of N_1 plants showing apparently normal meiosis and microsporogenesis were sterile, it is suggested that the main contributory factors for low seed setting or fertility were the pollen and ovule abnormalities caused by chromosomal aberrations and abnormal microsporogenesis. A linear relationship was obtained between radiation dose and the frequency of aberrant and sterile plants. *Plantago* has differentiated chromosomes. Evidence was obtained to show that the chromatic segments were more susceptible to radiation damage than the achromatic ones. (auth)

1586 CHROMOSOME SIZE, STRUCTURE AND RADIATION DAMAGE. J. Read (Wakari Public Hospital, Dunedin, N. Z.). p.217-27 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Experiments are summarized which strongly support the view that chromosome damage is the important factor in the lethal effect of ionizing radiations on plants. The shadow areas and lengths of chromosomes of four species of plants were measured on microphotographs, the four being chosen because measurements of the deoxyribonucleic acid (DNA) content of their nuclei were previously published. Evidence regarding the structure of chromosomes from electron micrographs and other sources is discussed, leading to the concept that a chromatid consists of two half-chromatids each composed of a hundred or so microfibrils. These microfibrils, each about 120 Å in dia with a 40 Å dia central hole, are supposed to be formed by winding a thread into a helix. The thread is made from histone wound around the Watson-Crick DNA helix. The manner in which the thread can be coiled to give the correct mass, length, and shadow area is described. The model is then applied to the breakage of *Tradescantia* chromatids by alpha particles. (auth)

1587 AN ATTEMPT AT CONTINUOUS METAPHASE ESTIMATION OF CHROMATID AND CHROMOSOME ABERRATION FREQUENCIES IN BROAD-BEAN ROOT MERISTEM CELLS IN THE PERIOD 2–23 h AFTER 50 r OF X-RAYS. S. H. Revell (Royal Cancer Hospital, London). p.229-42 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Cells of the broad bean (*Vicia faba*) were given 50 r of x rays, and the frequencies of chromatid and chromosome aberrations which arrived at metaphase were estimated during the 14 periods 2–3½ h, 3½–5 h, 5–6½ h . . . 21½–23 h after irradiation, by taking separate consecutive samples of metaphases accumulated by 0.1% colchicine. Chromatid aberrations were observed principally in the period 2–17 h, and chromosome aberrations principally in the period 11–23 h. The relative frequencies of different types of chromatid change were similar to those recently reported though the relative number of real chromatid breaks was even lower than expected. There was no evidence of a very high radiation sensitivity just prior to prophase; the percentage of cells carrying aberrations in the period 2–3½ h (37.2%) was only slightly higher than in the later periods 3½–5 . . . 15½–17 h, where the average was 27.7%. The frequency of chromatid breaks was uniformly low (highest value: 0.02 per cell). The relevance of these observations to some other published results is discussed. (auth)

1588 INDUCTION OF MUTATIONS IN BARLEY. RELATIVE EFFECTIVENESS OF GAMMA RAYS, ETHYL SULPHATE, ETHYL METHANE SULPHONATE AND SOME OTHER SUBSTANCES. H. Heslot (Institut National d'Agronomie, Paris), R. Ferrary, R. Lévy, and C. Monard. p.243-9 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In French)

Rika spring barley seeds were irradiated in a dry state by gamma rays or treated by soaking in aqueous solutions of neutral ethyl sulfate, ethyl methane sulfonate, and various other substances. The surviving plants (M_1) were kept under observation until maturity, the degree of sterility was determined and the chlorophyllous chimeras were studied. The ears of each plant were harvested and threshed separately. In the M_2, the progency of an M_1 plant is represented by a series of parallel lines, each line corresponding to an ear. The various types of chlorophyllous, morphological, and physiological mutations and sterility produced by genetic causes were noted. In view of the results, there is reason to believe that ionizing radiations—inducing mutations in cultivated spermatophytic plants—will soon be replaced by substances like ethyl methane sulfonate. (auth)

1589 THE INFLUENCE OF EXPOSURE TIME ON THE YIELD OF CHROMOSOMAL ABERRATIONS IN *TRADESCANTIA* POLLEN GRAINS PRODUCED BY FAST NEUTRONS AND GAMMA RADIATION. G. J. Neary, J. R. K. Savage, and H. J. Evans (Medical Research Council, Harwell, Berks, Eng.). p.251-7 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Inflorescences of *Tradescantia paludosa* were irradiated either with fast neutrons or with gamma radiation for exposure times ranging from 10 min to 48 hr. Chromosome-type aberrations were scored at metaphase of the pollen grain mitosis three to five days after irradiation. With fast neutrons the dose response for all types of aberration is linear. With gamma radiation there is a square-law component in the response for interchanges and intrachanges, but this component becomes progressively less important as the exposure time is increased. Thus, whereas with short exposures the RBE of fast neutrons compared to gamma rays falls as the dose is increased, with long exposures a limiting value of RBE is approached; this value is about 80. The significance of these results in relation to the mechanism of aberration production is discussed. (auth)

1590 THE FREQUENCY AND DISTRIBUTION OF INTERCHANGE AND ISOCHROMATID ABERRATIONS INDUCED BY THE IRRADIATION OF DIPLOID AND TETRAPLOID CELLS. H. J. Evans (Medical Research Council, Harwell, Berks, Eng.). p.259-70 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Interchange and isochromatid aberrations were scored in metaphase cells of primary root meristems of *Vicia faba* seedlings fixed between 4 and 7 hr after irradiation with 118 rad of Co^{60} γ radiation. Twenty-five hours before irradiation the roots were exposed to a colchicine solution for $3\frac{1}{2}$ hr, so that at the time of irradiation the meristems consisted of a mixture of diploid and tetraploid cells. The frequencies of both isochromatid and interchange aberrations in tetraploid cells were found to be twice the frequencies observed for diploid cells irradiated at the same stage in development, the frequencies of aberrations per chromosome were the same in 2n and 4n cells. Chromatid interchanges produced under the conditions of irradiation used are predominantly 2-hit aberrations, and the fact that this frequency in 4n cells is twice and not four times that found for 2n cells is believed to be a consequence of the doubling of the nuclear volume in 4n cells and of the limitation of the number of sites in the nucleus at which interchange can take place. This limitation is also indicated by the fact that, in both 2n and 4n cells, although the distribution of isochromatid aberrations between cells in Poissonian, the distribution of interchange is not. Detailed analyses of the distribution of aberrations within and between chromosomes shows that the frequency with which a chromosome is involved in an aberration is not a simple function of its metaphase length, and that the distribution of aberrations along the chromosomes is non-random. This non-random distribution within chromosomes is believed to be partly due to an excess of aberrations occurring in or near heterochromatic chromosome regions. (auth)

1591 X-RAY-INDUCED BREAKAGE IN CHROMOSOMES WITH DIFFUSE CENTROMERES. João Montezuma-de-Carvalho (Universidade, Coimbra, Portugal). p.271-7 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Attempts were made to study the conditions of breakage and reunion in chromosomes of the genus *Luzula*. Seedlings of *Luzula purpurea* (2n = 6) were irradiated with 654 r and fixations of the apical stem meristems were made at 24, 33, and 77 hr and 7 and 14 days later. Results so far indicate that all breakage and reunion is of chromosomes. No examples of breakage or reunion of chromatids was detected. The survival of major fragments without further change shows that apparently there is healing of broken ends. Although after irradiation there is no loss of chromatin in the *Luzula* system, there is, however, through the cell generations, a strong selection in favor of cells with the normal chromosome set and of cells with one reciprocal translocation. However, this somatic selection can be overcome if plant inflorescences are irradiated at the time of meiosis. Time for selection is then drastically reduced and with a dose of 600 r as high as 26% of the progeny seedlings have changed chromosome complements. (auth)

1592 EFFECT OF DIPLONTIC SELECTION ON THE FREQUENCY AND SPECTRUM OF MUTATIONS INDUCED IN POLYPLOIDS FOLLOWING SEED IRRADIATION. M. S. Swaminthan (Indian Agricultural Research Inst., New Delhi, India). p.279-88 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Polyploid plants, by virtue of their ability to tolerate chromosome deficiencies and duplications to a great extent, yield a large frequency of viable mutations. The mutation frequency is however lower in an allopolyploid like Upland cotton (*Gossypium hirsutum*, 2n = 52), which tolerates only minute deficiencies, in comparison with an allopolyploid like bread wheat (*Triticum aestivum*, 2n = 42), in which whole or part chromosome deficiencies are readily viable. In experiments involving the treatment of dry seeds with a wide range of doses of x rays, γ rays, fast neutrons, and thermal neutrons, it was found that in *G. hirsutum* diplontic or intra-somatic selection greatly reduces the chances of a mutation finding expression in the gametes. In *T. aestivum*, however, 3–4 independent ear primordia are already differentiated in the seed subjected to irradiation and each ear appears to develop from one or two initial cells. As a result, the effect of diplontic selection is not as drastic as in cotton. Subjection of seeds to recurrent irradiation was found to be effective in overcoming the limitation placed by diplontic cell selection on the realization of mutations. The nature of polyploidy in the plant as well as the histogenetic aspects relating to the origin of inflorescences condition the mutation rate in polyploid plants following seed irradiation. The spectrum of induced mutations is narrow in bread wheat and serves as a measure of the extent of gene duplication existing among the different genomes. Among hexaploid wheats the frequency of mutations is highest in *T. aestivum* and lowest in *T. spelta*. The speltoid suppressor gene Q seems to be responsible for the high mutation rate found in irradiated populations of bread wheat. (auth)

1593 EARLY-FLOWERING NEUTRONIC MUTANTS IN PEAS. S. J. Wellensiek (Landbouwhogeschool, Wageningen, Netherlands). p.321-6 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

In 1957 dry seeds of the cultivar Dominant were irradiated for 30 min at 5.1×10^8 n/cm^2 sec with a pile level of 0.5 kw. Dominant is a very late-flowering cultivar, usually flowering from the 16th stem node. In one M_2-line, two early flowering plants were found. One bred true in M_3 and in M_4 (5 lines and mass). The other one, however, segregated in M_3 from very early to very late. Four very early

M_3 plants were selected and these bred true in M_4. In 1960 Dominant flowered from the 15th stem node. The early mutants flowered from the 8th node, the very early mutants from the 6th node, respectively 13 and 28 days earlier than Dominant. All differences are highly significant. The mutants are interesting from a breeding point of view, and even more so from a theoretical one. The problem is whether they should be considered as two separate mutations in one seed, or whether the very early-flowering mutant is an after-effect of the early mutation. This problem is offered for discussion. (auth)

1594 X-RAY-INDUCED PSEUDOCHIASMATA: THEIR NATURE AND CONSEQUENCES. Ashraful Haque (Univ. of Dacca, Pakistan). p.327-32 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The number of radioinduced anaphase bridges during cell mitosis shows no significant increase with the application of infrared rays. This is contrary to what happens in the case of radioinduced chromosomal breakage reunion. The result of the infrared action is thus incompatible with the breakage-view in regard to the origin of these radioinduced bridges. The total breakage-reunion observed in the next cell cycle may not always represent the true breakage-reunion. In some of the cells the total number will include the mechanical-breakage-reunion inherited from the previous mitosis containing the anaphase bridges. The data presented do not lend support to the hypotheses put forward in the past to explain the nature of these chromosomal bridges. (auth)

1595 EFFECTS OF COMBINED TREATMENTS OF MYLERAN WITH RADIOMIMETIC COMPOUNDS AND X-RAYS. J. Moutschen-Dahmen and M. Moutschen-Dahmen (Université, Liège). p.333-44 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In French)

Seeds of *Vicia faba* were treated with Myleran in combination with other treatments: 8-ethoxycaffeine, maleic hydrazide, nitrogen mustard, tri-ethylene-melamine, bis-epoxybutane, and different doses of x rays. In all cases, interferences between effects occurred. Some combined treatments were found to be more efficient than the sum of effects of single treatments. Some were less. Very delayed effects were obtained; their bearing on mutagenesis is discussed. Changes in types of lesion and in the distribution of chromosome breaks in the genomes are observed. In some cases, the specificity of breaks localization is enhanced. The sensitivity of cells with one nucleolar organizer induced with 8-ethoxycaffeine is higher than that of normal cells. Cells with different numbers of nucleolar arms were induced with maleic hydrazide. A comparison between these experiments made it possible to distinguish the role of the nucleolar organizer and some heterochromatic components in modifying sensitivity to Myleran. (auth)

1596 RELATIVE BIOLOGICAL EFFICIENCIES OF IONIZING RADIATIONS ON THE INDUCTION OF CYTOGENETIC EFFECTS IN PLANTS. K. C. Bora (Atomic Energy Establishment, Trombay, India). p.345-57 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

A general survey was made of the available RBE data of ionizing radiations on the induction of chromosomal aberrations, mutation, inhibition of mitosis and growth, rate of germination, and survival of seedlings. A comparative study of the methods of RBE experiments and the results was made with a view to ascertaining the relative importance of various factors such as the level of the radiation dose, the manner in which a dose is delivered, external and internal environment of the irradiated material, and the type of material and effect that must be considered for correct evaluation of RBE of any radiation. Significance of RBE in the determination of relative and effective radiation doses for various uses was considered. The usefulness of RBE in seed irradiation, the interpretation of some biological effects in relation to RBE values, and relationship between RBE, LET, and radiosensitivity are also discussed. (auth)

1597 THE USE OF INTERCHANGES INVOLVING A AND B CHROMOSOMES IN STUDYING ARTIFICIAL MUTAGENESIS IN MAIZE. Angelo Bianchi and Marialuisa Contin (Università, Milan). p.359-69 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Crossing of yg_2 (yellow-green-2 seedlings), sh_1 (shrunken endosperm -1) maize by TB -9b (having the distal part of the short arm of chromosome 9 translocated to the B centromere) gives normal and shrunken endosperm kernels. While the second class gives only normal seedlings, the first produces both normal and yellow-green seedlings. Genetical and cytological evidence demonstrates that the normal seedlings from the shrunken endosperm kernels derive from embryos of constitution $yg_2Yg_2Yg_2$, while the other two types of seedlings from normal endosperm kernels are respectively yg_2Yg_2 and yg_2. That is, classes of embryos are available which differ by the presence of 3, 2, or 1 restricted segments of the short arm of chromosome 9. Preliminary experiments show that x irradiation of kernels from this cross causes chiefly albino sectors in the leaves of yg_2 genotype and yellow-green sectors on the green background of yg_2Yg_2 and $yg_2Yg_2Yg_2$ genotypes. However, the frequency of such events varies not only according to the leaf selected for the scoring, but also with the genotype. In all cases the relationship between sector frequency and x-ray doses is polynomial: the curves appear basically the same for the types yg_2Yg_2 and yg_2, and the exponent of the dose, although greater than unity, appears lower than that of the $yg_2Yg_2Yg_2$ type. X irradiation delivered at a high rate (675 r/min) proved to be more effective in the production of mutant markers in the three genotypes than when delivered at a low rate (28.2 to 20 r/min) as well as fractionizing the dose at ½ to 1 hr intervals. (auth)

1598 RADIATION EXPERIMENTS ON *TRITICUM DURUM* AND *T. VULGARE*. R. E. Scossiroli (Università, Pavia, Italy), D. Palenzona, and B. Rusmini. p.373-86 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The effects of two doses of x rays (10 and 20 kr) applied to seeds of the wheat varieties: *Cappelli* (*T. durum*), *Damiano*, and *Mara* (*T. vulgare*) were studied at different levels during growth of the seedlings, the mature plants, and spikes. On the seedlings the length of coleoptile and of the main root at three and five days of age were found to be reduced by the treatment. Interactions Head x Treatment were found to be significant for these traits. Such findings show a different response of different heads to the same treatment. On the mature plant the number of internodes was reduced and they were shorter so that the plant heights were found to be reduced in the treated series when compared with the control. Interactions Head x Treatments were found to be significant for such traits. On the heads a reduction of the internode length was observed in *T. vulgare* and a reduction of the number of spikelets and of the number of seed set was found in T. durum and T. vulgare. (P.C.H.)

1599 EFFECTS OF RADIATIONS AND CHEMICAL MUTAGENS IN DURUM AND BREAD WHEATS. G. T. Scarascia, S. Avanzi, A. Bozzini, T. Cervigni, F. D'Amato, B. Donini, and M. Giacomelli (C.N.R.N., Rome). p.387-401 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

In an attempt to find the experimental mutability in durum wheat, a species not very much investigated so far, a research program on the comparative effects of radiations (x rays, thermal neutrons, and fast neutrons) and chemical mutagens (β-propiolactone, ethylene chloride, diethyl sulphate, ethyl methansulphonate) was developed in the Italian varieties Aziziah, Cappelli, and Russello. The results of observations on seedling growth in controlled conditions, plant survival in the field, and frequency of chimeras in F_1 are presented. As to seedling growth, if the root/shoot ratio is considered, the growth-depressing effect of the various agents studied expresses itself according to the following series of decreasing efficiency: $n_{th} > n_f >$ Chemical $\geqq$ X; root growth depression is most accentuated in thermal-neutron-treated material. Field survival expressed as adult plants/seedlings ratio follows a series of relative efficiencies of the agents parallel to that established for growth depression (only a fraction, sometimes very small, of seedlings is able to survive to the adult stage in thermal-neutron-treated material). Among the varieties investigated, Aziziah was found to be the most radiosensitive. A special type of chlorophyll chimera (chlorotic sectors undergoing rather rapid necrosis) is induced by some chemical mutagens, the highest frequency (22.3%) being observed in Aziziah after ethyl methansulphonate treatment. (auth)

1600 COMPARISON OF THE EFFECTS OF X-RAYS AND THERMAL NEUTRONS ON VIABILITY AND GROWTH OF SWEET CLOVER (MELILOTUS ALBUS) AFTER IRRADIATION OF DRY SEEDS. Alexander Micke (Universität, Göttingen, Ger.). p.403-10 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The comparison is based on x-rays (5, 10, 20, 40, 50, 60, 80, and 100 kr) and thermal neutron (2.5, 5, 10, 20, 40, 80 × 10^{12} n/cm^2) doses. Germination and sprouting ability of the irradiated seeds were not affected, either by x rays or by thermal neutrons. During the seedling stage radiation damage was reflected by the death of plants in relation to the doses applied. Regarding a survival rate of 30% an x-ray dose of 60 kr corresponded to 80 × 10^{12} n/cm^2. Low doses of thermal neutrons result in a stimulation of height growth. After the application of low doses of x rays on dry seeds this effect was not observed. Isotomous branching of stalks were found after x irradiation as well as after the application of thermal neutrons. (auth)

1601 THE EFFECT OF GAMMA RADIATION ON THE MULBERRY EMBRYO CULTIVATED IN A MEDIUM CONTAINING ASCORBIC ACID. K. Hazama (Sericultural Experiment Station, Tokyo). p.411-17 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The experiment was carried out to clarify the effect of radiation on the mulberry embryo cultivated in agar medium containing ascorbic acid (one of the reducing substances). Embryos irradiated with doses from 10 to 40 kr (dose-rate 40 kr/h) in agar medium grew during cultivation but were slightly suppressed. In the ascorbic acid medium, growth was apparently suppressed as concentration was increased within the range 10^{-2}M and 10^{-4}M. The suppression was chiefly due to the effect of ascorbic acid in medium but not to pH value. When irradiated with a 5 kr dose (dose-rate 40 kr/h), the growth of embryos in the ascorbic acid medium (10^{-4}M) was more suppressed than in those embryos which had not been irradiated. A small quantity of ascorbic acid was detected in the medium one week after irradiation, but this was not found in the medium which had not been irradiated. On the other hand, the aqueous solutions of ascorbic acid received 5 kr, 10 kr, 20 kr, and 40 kr doses (dose-rate 10 kr/h); the remaining ascorbic acid was measured every day, having been oxidized by oxygen in the air. The ascorbic acid decreased day by day and was perfectly oxidized 5 days after irradiation except in the case of a 5-kr dose. The reason for suppression of embryo growth is considered to be due to the effect of the remaining ascorbic acid which had not been oxidized. (auth)

1602 MUTATIONS INDUCED IN ENDOSPERM AND SEEDLINGS OF MAIZE FOLLOWING X-IRRADIATION AND DIEPOXYBUTANE TREATMENT OF MATURE POLLEN. A. Bianchi, G. Mariani, and P. Uberti (Università, Milan). p.419-39 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Plants homozygous for $lg_1a_1sh_2Pr$ were fertilized with pollen $Lg_1A_1Sh_2Pr$, treated with diepoxybutane and/or 1000–2000 r. Diepoxybutane turned out to be a good inducer of mutant endosperm sectors. However, it had a negligible effect on the F_1 generation. An interaction may exist between the action of diepoxybutane and x-ray influence on mutation rate. The x rays may or may not give different results when delivered at 30 or 230 kvp. In addition, the following conclusions could be drawn: Pr is lost about one-third less frequency than A_1Sh_2, the latter usually being lost together; the frequency at which Pr and A_1Sh_2 are lost is an exponential function of x-ray dose, taking into consideration the whole endosperm mutations; the sector losses in the material which is x rayed only increase almost linearly with the dose; the material treated with diepoxybutane and x rays does not show concomitant variations for sectorial losses at the various x-ray doses since the x-ray effect is masked by the relatively more obvious influence of diepoxybutane as inducer of sectors; the frequency of induced germless is exponentially related to x-ray doses, while the remaining dominant lethals appear as an almost linear function of the doses; and the lethality in a_1sh_2 kernels is at least twice as high as in A_1Sh_2Pr kernels. (auth)

1603 INFLUENCE OF PLOIDY DOSE LEVELS ON RBE AND THE PROCESS OF ELIMINATION OF CHROMOSOMAL ABERRATIONS. B. Y. Bhatt, K. C. Bora, and S. H. Patil (Atomic Energy Establishment, Trombay, India). p.441-59 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Seeds of tetraploid Triticum durum and hexaploid T. aestivum wheat were irradiated with 3000 to 100,000 r of 250 kvp x rays, fast neutron doses from 2575 to 10,300 rads, and thermal neutron doses of 8.8 × 10^{12} n_{th}/cm^2 to 174 × 10^{12} n_{th}/cm^2 with a view to studying the ploidydose level effect on the relative biological efficiencies of the radiations as well as the elimination of chromosomal aberrations. It was shown that RBE for fn/x ray is not significantly influenced by the ploidy but was dependent on dose level. For chromosome reunions RBE values ranged from 9 to 5 from lower to higher doses. It was further estimated that 1 rad of fast neutrons is equivalent to about 6.5×10^9 n_{th} for the hexaploid: 1 r of x rays was found to be equivalent to about 0.6×10^9 n_{th}/cm^2 at low dose and 1×10^9 n_{th}/cm^2 at high dose levels. The rate of elimination of chromosomal aberrations was studied for 18 days after germination of the irradiated seeds. Fixations were made mostly at intervals of 24 hr. It was observed that different aberrations were eliminated at different rates. Although the pattern of the rate of elimination was the same in both the ploids, the slopes of the elimination curves were different even when the aberrations were expressed on a per chromosome basis. With high doses the rate of elimination of chromosome interchange appeared to be exponential during the first week; with smaller doses, however, although the elimination process was rapid at first, the exponential pattern was not evident. The frequency of aberrations surviving at the end of the period was about the same for all doses. (auth)

1604 A NEW METHOD OF INTERNAL IRRADIATION OF BUD-GRAFTS OF FRUIT TREES FOR INDUCTION OF MUTATIONS. D. Stanković (Inst. for Uses of Nuclear Energy in Agriculture, Veterinary Science and Forestry, Belgrade). p.461-4 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

A short description is given of a suggested new method for internal radiation of bud-grafts of fruit trees by means of P^{32}. Branches treated in this way should be used for budding immediately after removal from the radioactive solution. The P^{32} causes hereditary changes in the branches treated. (auth)

1605 GENETIC PROBLEMS OF MUTATION BREEDING IN PEAS (*PISUM SATIVUM*). W. Gottschalk (Universität, Bonn). p.465-74 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

The frequency of x-ray induced mutants in the segregating families of the X_1 generation is determined by the chimera status of the X_1 plants and by the specific genetic circumstances of the mutated genes. These two factors were investigated after seed irradiation of a pure line of *Pisum* on nearly 300 mutated genes. The total segregation of all analyzed segregating X_2 families was 6.4 : 1. This value differs considerably from a 3 : 1 segregation. The reason for this is the fact that only a few X_1 plants have a uniform genetic constitution. Most of the X_1 plants were chimeras with just a small mutated sector. Therefore the proportion of the mutants in the segregating families is considerably reduced and attains in exceptional cases values of 20–40 : 1 only. The analysis of the mutated genes in the following generations (X_3–X_5) shows for most of the investigated genes not a 3 : 1 segregation, but frequently a high deficit of mutants. The investigation of 129 genes in the following generations gave a total segregation of 26,581 normal: 6292 mutated plants, a percentage of 19.1 only. This genetically-caused deficit of mutants leads to an additional reduction of the number of homozygously mutated plants in the X_2 families. With an increasing x-ray intensity on dormant seeds the yield of X_1 plants diminishes in relation to the applied dose. In *Pisum* the number of individuals in X_2 families is often so small that a considerable proportion of the mutated genes does not appear in a homozygous but only in a heterozygous form. Therefore many of the mutated genes cannot be identified, they segregate for the first time in the X_3 generation. To date 297 genes were investigated, and only 180 were found in the X_2 generation, the remnant of 117 genes (= 39.4%) appeared in the X_3 generation. Consequently, in working with species with a small fertility, to obtain a considerably higher number of mutants is likely to be obtained, if not only the segregating, but all the families of the X_2 generation are used for the breeding of the X_3 generation. An early flowering mutant, flowering 10–13 days earlier than the basic material, was found. (auth)

1606 A STUDY OF DIFFERENCES IN THE RADIOSENSITIVITY OF SOME INBREDS AND HYBRIDS IN MAIZE. N. K. Notani (Atomic Energy Establishment, Trombay, India). p.475-84 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Seeds of four inbred lines (D_4, D_{65}, N_6, and Ite 701) and two hybrids ($D_{65} \times D_4$ and Ite 701 × N_6) after having been stabilized for their moisture content were exposed to x-ray doses of 10,000, 20,000, and 30,000 r and to thermal neutrons for 3, 6, and 9 h (flux rate 9.0×10^8 n_{th}/cm^2 sec), respectively. The object of the experiment was to examine any differences in the radiosensitivity of these inbred lines and to study the possible buffering capacity of the hybrids to radiation. The criteria used for determining radiosensitivity were: seedling height and percentage survival of plants 30 d after sowing. The inbreds used here form the parents of two established single-cross hybrids. Not only did the two inbreds of each single cross show statistically significant differences in their response to radiation but they also differed from each other. Thus, D_4 was more radioresistant than inbred D_{65} and Ite 701 more so than N_6. In general, only the high doses resolved these differences. These differences among the inbreds are perhaps due to selection for diverse types which characterize their isolation for the production of hybrids. Both the hybrids showed a better survival stand than either one of their parents. The implications of these, vis-à-vis genetic homeostasis, are discussed. (auth)

1607 THE UTILIZATION OF X-RADIATION FOR RICE IMPROVEMENT. H. W. Li, C. H. Hu, W. T. Chang, and T. S. Weng (Academia Sinica, Nankang, Taiwan, China). p.485-93 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

For x-ray treatment of varying doses, both dormant and water-soaked seeds were used. In the course of three years, 37 promising lines derived from six of the 10 x-rayed varieties selected. The rest are still under selection and testing. The said promising lines consisted of 20 high-yielding (normal morphologically as well as physiologically), five short-culmed, three erectoid (also short-culmed, three erectoid (also short-culmed, but marked by high stiffness of the culm), four multi-branched, and two early types, which all excelled their mother varieties in yield. They were further tested out against varying levels of fertilizer, especially nitrogen, and 15 of them, when supplied with fertilizer, showed higher productivity as compared with their mother varieties. One line of high-yielding type surpassed its mother varieties by as much as 27.4%. The erectoid types, which were expected to be able to stand high fertility, failed to come up to expectation as compared with their mother varieties in the fertilizer response test, because they were seriously damaged by sheath rot disease. This defect will be improved by means of hybridization in the future. (auth)

1608 MUTATIONS INDUCED IN RICE BY IONIZING RADIATIONS AND CHEMICALS. T. Matsuo and Y. Onozawa (Tokyo Univ.). p.495-501 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Studies were made on the modification of biological effects caused by ionizing radiations by post-treatments with chemicals, and on the mutations induced by radiations and chemicals at doses of nearly LD_{50} on the dry seeds of rice. Doses of LD_{50} in a single application of radiations or chemicals on the dormant seeds were determined as follows: x rays: about 30 kr; thermal neutrons: about 4.0×10^{13} n_{th}/cm^2; diepoxybutane: 0.1% for 60 min; β-propiolactone: 0.5%, 60 min. Post-treatments of seeds by colchicine (0.05%, 24 h) increased the fertility of M_1 plants compared with a single application of radiation, but revealed no effect on mutation frequency when combined with x rays (25 kr), and decreased the frequency when combined with neutrons (3.9×10^{13} n_{th}/cm^2). Diepoxybutane and β-propiolactone, which are already known as mutagenic substances, affected germination and survival of M_1 plants in the case of a single application of chemicals or when combined with radiation. However, fertility and mutation frequency of the treated materials increased when these chemicals were used for post-treatment after x irradiation, but no effect was seen on the mutation frequency when they were combined with treatment by thermal neutrons. No different spectra of chlorophyll mutations were obtained by a comparison of the effect of radiation alone with the effect of chemicals combined with radiation. The frequency of viable and visible mutations at the heading and mature stages was parallel to that of chlorophyll mutations at the seed-bed stage, that is, this frequency was highest in the case of thermal neutron treatment; x rays were at the next level with a little difference only; frequency was least of all with Diepoxybutane. Radiation treatment significantly increased the genetic variances of stem length and grain weight in those M_3 progenies which were taken from mutated lines showing these visible characters though the mean value of each treated plot was almost the same as that of non-treated plots. (auth)

1609 EFFECTS OF GAMMA IRRADIATION OF SOME VARIETIES OF WHEAT SEED ON THE MORPHOPHYSIOLOGICAL CHARACTERISTICS OF THE SEEDLINGS. M. Sarić, R. Curić, I. Cerić, and D. Hadžijev (Inst. for Agricultural Research, Novi Sad. Yugoslavia). p.503-17 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Investigation of the practical application of radiation in crop production was done for two reasons: to obtain new plant forms by changing hereditary characteristics, and to increase the immediate productivity of the plant without the preceding change in its heredity. Preliminary study of such application with the aim of obtaining bigger yields of cultivated plants has not given unequivocal results. Earlier work shows that there are definite doses of radiation which act as stimulants on the growth and development of the plant or on its yield. However, the results also show that no definite relation exists between the stimulant effect on the yield and the radiation dose. The effect of the irradiation of wheat seeds by gamma rays was analyzed on some morphophysiological characteristics of seedlings. Wheat seeds of varieties Bankut 1205, S. Pastore, Mara, and Fortunato were irradiated at doses of 500, 1000, 2000, 2500, 5000, 7500, 10,000, 12,500, and 15,000 r. The seeds were sown in petri dishes with distilled water only and without nutrient elements. Twelve days later the seedlings were analysed. The results showed that some of the investigated doses were stimulant and others inhibitory. The percentage of germination decreased with increase in dose, as also did the height and weight of the seedlings. Reaction of the varieties towards the same dose was different. Small doses up to 2000 r had a stimulant effect in comparison with the control. The intensity of respiration also varied with the radiation dose, but there was no definite relation between the intensity of respiration and the radiation dose. Similarly, the content of plant pigments (chlorophyll, carotene, and xantophyll) and of sugar varied with the dose of radiation, but no regularity was found. Variety differences were noticed. (auth)

1610 RADIOSENSITIVITY OF PERENNIAL R.v.P. PASTURE-TYPE RYE GRASS SEEDS IN RELATION TO WAVELENGTH. R. de Loose and H. Reyntens (Station d'Amélioration des Plantes de Grande Culture, Lemberge, Belg.). p.519-5 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In French)

Seeds from one plant only, which were stored in an atmosphere with a relative humidity of 65%, were exposed to x rays (voltage of the tube: 90-80-60-45-30 kv) and to cobalt-60 gamma rays. Both treatments were designed to produce the same dissipation of energy in the tissues. Chemical dosimetry ($Fe^{2+} \rightarrow Fe^{3+}$) was used. With the x rays, it was not possible to observe statistically significant differences in respect of the different voltages. On the other hand, the seeds seemed to be more sensitive to cobalt-60 gamma radiation, particularly with regard to reduced survival rates. (auth)

1611 THE EFFECT OF X-RAYS ON THE APOMIXIS IN *POA PRATENSIS*. G. Julén (Food and Agricultural Organization of the United Nations, [Rome]). p.527-32 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

From x irradiated seeds of apomictic *Poa pratensis* a great number of plants, very different from the mother plant with respect to morphological characters were obtained. Many of these aberrants are chimeras. Most of them were less luxuriant than the mother plant, but a few were quite as good or even better. Through progeny tests it was found that many plants produced seed in a sexual way. Out of 286 tested plants, 38 had entirely sexual seed formation, 101 were still apomictic, and in the remaining 147 seed were formed in a sexual as well as in an apomictic way. The breakdown of the apomixis seems to be completely independent of changes in morphological characters, since complete, as well as partial sexual seed formation occurred in morphological aberrants as well as in plants without any visible changes. Plants which are seemingly quite uniform—like or different from the mother plant—can be chimerical with regard to the seed-formation system. No difference in chromosome number was found in apomictic and sexual plants. In the second generation, the progeny from sexual plants segregate into apomictic, partially sexual, and sexual plants. Among 155 tested X_2 plants, being progeny of 14 sexual X_1 plants, 93 were sexual, 38 partially sexual, and 24 apomictic. The progeny from plants obtained in a sexual way from partially sexual plants segregate in the same way, but in this case the number of apomictics seems to be somewhat higher. Among 68 tested plants of that category, 37 were sexual, 12 partially sexual, and 19 apomictic. Among the apomictic plants obtained in this way, plants with luxuriant growth were found, as well as very weak plants. Luxuriant apomictic plants were obtained in some cases even if the sexual mother plant was weak. Controlled crosses between plants with induced sexuality and normal apomictics were made. The progeny shows a very big morphological variation. However, the sexuality of this material was not tested. The results obtained indicate that it would be possible to induce sexuality by x rays in an apomictic species, make crosses, and in later generations select new apomictic types with favorable morphological characters. (auth)

1612 EFFECTS OF HIGH DOSES OF X-RAYS ON SEEDLING GROWTH IN WHEATS OF DIFFERENT PLOIDY. D. L. Palenzona (Università, Pavia, Italy). p.533-42 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Seeds of three species of wheat were treated with x rays up to 240,000 r with the object of studying the behavior of species of different degrees of ploidy belonging to the same genus. The degrees of humidity of the seeds at the time of radiation were 5 and 13%. It was possible to identify, on the basis of the data obtained, the influence of the degree of ploidy, the degree of humidity, and the trait considered on radiosensitivity in general and on the manifestation of the reversal phenomenon. Examination of the behavior of certain characters, such as the dry weight of the seedlings, which gives an indication of the metabolic activity of the irradiated material, suggest that the reversal phenomenon might also include an inhibition of the autocatalytic activity (reduplication) of the hereditary material while the heterocatalytic activity (gene function) remain undamaged. At even higher doses this latter activity would also be inhibited and radiation death occurs. (auth)

1613 RELATION BETWEEN POLYPLOIDY AND EFFECTS OF NEUTRON RADIATION ON WHEAT. Seiji Matsumura and Mitsuya Nezu (National Inst. of Genetics, Misima, Japan). p.543-52 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

After exposure to 37.5 × 10^{12} n_{th}/cm^2 and 5 krad of fast neutrons, *T. monococcum* did not germinate, while the seeds of *T. durum* and *T. vulgare* germinated but most of the seedlings died in an early stage. At 20.6 × 10^{12} n_{th}/cm^2 and 2 to 2.5 krad of fast neutrons most of the seedlings of *T. monococcum* died, while in *T. durum* and *T. vulgare* slow growth of the seedlings continued. The higher the dose of thermal and fast neutrons, the more delayed were germination and growth of seedlings, the more reduced were survival rate, height of mature plants and seed fertility and the more increased were chromosome aberrations and chlorophyll mutations. In general, *T. monococcum* is the most sensitive to thermal and fast neutrons and *T. durum* is, unexpectedly, the most resistant. There is no significant difference between *T. durum* and *T. vulgare*. In comparison with the results obtained by x and gamma irradiations, the thermal-neutron flux per 1 r is calculated for 2x, 4x, and 6x species as an order of 10^9 n_{th}/cm^2. Also relative biological effectiveness (RBE) for fast neutrons is calculated as follows: for germination rate 3 to 3.5, for seedling growth 6 to 10, for seed fertility 12 to 20, and for chromosome aberration 8 to 25. Namely, RBE is lower for the characters observed in earlier stages than those of mature plants, especially in polyploids. (auth)

1614 INFLUENCE OF LOW DOSES OF IRRADIATION (X-RAYS AND GAMMA RAYS OF COBALT-60) ON POTATO SEED. O. Fischnich, C. Paetzold, and F. Heilinger (Forschungsanstalt für Landwirtschaft, Brunswick). p.553-64 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Parallels between the effects of irradiation and growth promotion and inhibiting substances were studied. Tubers of various varieties were irradiated at different times (October–May) with doses of <100 r. Those which had not sprouted, or sprouted only a little—the latter partly before or after irradiation—were stored in rooms with constant temperatures (4°, 7°, 18°C) or planted in pots or in the field. The length, number, and weight of the sprouts, the weight of the tubers, and their composition were tested at certain intervals. After planting, we measured the height of the plants, number of stalks, yield, and the size of the tubers when harvested. It was found that the reaction of the tubers depended on the irradiation dose, the physiological condition of the material at the time of irradiation, and on conditions during storage and after planting. Irradiation was effective in sprout promotion, but the length and number of sprouts showed indifferent reaction and even a decrease, depending on variety and environment. Sprout and tuber weight, composition, and yield from the planted material was not then influenced. (auth)

1615 SHORT-CULM MUTATIONS IN RICE INDUCED BY P^{32}. T. Kawai, H. Sato, and I. Masima (National Inst. of Agricultural Sciences, Hiratsuka City, Japan). p.565-79 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Short-culm mutations were induced in rice, variety Norin No. 22, by radioactive P^{32} treatment. In 1955 and 1956, germinated seeds were grown for 14 d in a $Na_2HP^{32}O_4$ solution, with a dose of 12.5 microcuries per seed, where they absorbed P^{32}. From 91 R_1 plants, 216 R_1 ear progenies (12,403 R_2 plants) were obtained, and short culm plants, or strains in which yields seemed to be not notably decreased, were screened in the R_2, R_3, and R_4 generations. In 1958, in the R_3 and R_4 generations, 137 short culm strains were obtained and 110 of them bred true; in 1959, 68 promising true-bred strains were tested by the triple lattice design field test regarding short culms, yield, and changes in other characteristics. The culm length significantly decreased in 47 strains, compared with the original variety, and there were differences in degree of lodging. Other characteristics, such as heading date, number of tillers, ear length, grain size, and shape, were also changed in these mutant strains, and increase in tillers was frequently observed. Grain-weights per plant of 18 strains out of the 47 short-culm mutant strains were increased, and the increase in three strains was significant. These 47 strains originated from 29 R_1 ears. The phenotypic changes observed in the strains were presumed to be due to simple genetic changes, because of their homozygosis attained in early generations. Simultaneous changes of characteristics in these strains seemed to be due to pleiotropic effect of these genetic changes. In screening short culm plants in the R_2 generation, plants with simultaneous changes of other morphological characteristics were more frequently found to be short-culm mutants, by the test in later generations, than those without conspicuous changes. When short culm plants of the same types appeared in R_2 strains with over a 5% frequency, they were found to be short-culm mutants more often than those with less than a 5% frequency. The results show that, by radiation, a long culm variety of rice can be changed to a short-culm form without impairing its productivity. (auth)

1616 THE EFFECT OF GAMMA RAYS ON BUDS OF THE MAX RED BARTLETT PEAR TREE VARIETY. P. Dommergues (Station Centrale d'Amélioration des Plantes, Versailles). p.581-9 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In French)

The Max Red Bartlett variety was chosen because of the red pigmentation of its young leaves and young wood. The object was to produce cellular clones devoid of anthocyanin. Dormant branches were irradiated with cobalt-60 at the end of the winter. The primary effects were of the normal type with one exception: in this case there were sharp bends in the branches, accompanied by morphological anomalies, and secondary sprouts were growing in an irregular pattern. In 15 to 25% of the irradiated and well-developed buds, it was possible to observe some chimeras produced by green cellular clones on the normally red epidermis of the young sprouts. This enormous percentage of chimeras of the same genetic type entails an ontogenic effect of gamma radiation. The Max Red Bartlett variety would appear to be a perieline chimera, whose deep layers would be in keeping with its original Bartlett parentage. By killing the superficial layers of the apex, the gamma rays seem to permit the deep layers to re-form the destroyed tissues and produce green and red chimeras. This theory is a generalization of the theory on the carnation. (auth)

1617 SOME ASPECTS OF IRRADIATION OF SEEDS WITH IONIZING RADIATIONS. B. Y. Bhatt, K. C. Bora, A. R. Gopal-Ayengar, S. H. Patil, N. S. Rao, H. K. Shama Rao, K. C. Subbaiah, and R. G. Thakare (Atomic Energy Establishment, Trombay, India). p.591-607 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Seed irradiation studies are being made on a number of plants including several varieties of Oryza sativa, Zea Mays, Sorghum, Citrullus vulgaris, Arachis hypogoea, Setaria italica, and Plantago ovata. Some of the biological criteria under investigation are: radiosensitivity, sex ratio, mutation frequency, and morphological and cytological aberrations. Radiosensitivities of over 50 varieties of plants to x rays, neutrons, and gamma rays were determined and considerable difference was found between different varieties. Mutations obtained so far include those affecting the morphology of the seed, chlorophyll and pigment development, tillering habit, height, and flowering time. Stimulating effects of low doses of thermal neutrons were also recorded in several species. It was observed that the ratio of male and female flowers was altered by pile neutrons in favor of female flowers in two varieties of watermelon. Morphological variations affecting the plant habit and fruit are discussed with special reference to those in groundnut. (auth)

1618 X-RAY-INDUCED MUTATIONS IN RICE. J. Bekendam (Ministry of Agriculture, Fisheries and Food, Agricultural Univ., Wageningen, Netherlands). p.609-29 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

X-ray experiment was set up with two rice varieties, Holland and Nickerie. Holland is a medium-grain variety, susceptible to lodging, and Nickerie is a long-grain variety with stiff straw and susceptible to *Cercospora*. The experiment was carried out in Surinam during the years 1955–1959. Samples of 3 × 100 or 4 × 100 dormant seeds from both varieties were subjected to various doses of x rays (50 kv or 210 kv). Each time a sample of 100 seeds was irradiated (water content 14–16%). Radiation to the Holland seeds was administered as they lay in a single layer and to the Nickerie seeds as they lay several layers thick. In the X_1 generation germination percentage, survival to maturity, fertility of the heads, and number of heads of each X_1 plant were examined. Apart from the determination of the chlorophyll mutation frequency on young X_2 seedlings, induced mutations were observed in the field from the X_2 to the X_4 generation. Among the induced mutations observed, several were useful from the breeder's point of view. (auth)

1619 WATER CONTENT, WAVE-LENGTH AND SENSITIVITY TO X-RAYS IN BARLEY. A. Moës (Faculty of Agronomy, Gembloux, Belg.). p.631-41 of "Effects of Ionizing Radiations on Seeds." Vienna, International Atomic Energy Agency, 1961. (In English)

Piroline spring barley seeds were irradiated and then planted 24 hours later. Contrary to previously published results, it was concluded that with longwave x rays there is an increase in radioresistance to higher doses of x rays when the water content of the seed is reduced. (auth)

1620 IONIZING RADIATIONS: BIOCHEMICAL, PHYSIOLOGICAL AND MORPHOLOGICAL ASPECTS OF THEIR EFFECTS ON PLANTS. J. E. Gunckel and A. H. Sparrow (Brookhaven National Lab., Upton, N. Y. *and* Rutgers Univ., New Brunswick, N. J.). p.555-611 of "Encyclopedia of Plant Physiology." Berlin, Springer-Verlag, 1961. (BNL-4039)

Recent work with ionizing radiations of major interest, their relative biological effectiveness, possible mechanisms involved in their action, methods of exposure, factors influencing plant radiosensitivity, morphogenetic responses of plant organs, and the physical, biochemical, and physiological changes in representative molecules, both *in vitro* and *in vivo*, which may be related to modifications in the growth and/or development of plants are summarized. Radiation biochemistry and physiological aspects of irradiation responses are discussed. The complex chain of events, from the initial physical event of energy transfer through to the eventual detectable biological effects at a gross level, is outlined with examples. Radioinduced changes are discussed with reference to: auxin (IAA) synthesis, DNA synthesis and mitotic rate, amino acid and protein synthesis, respiration, enzyme activity, growth inhibition or stimulation, photosynthesis and pigmentation, the flowering response, and other miscellaneous effects. Factors which influence the tolerance or radiosensitivity of plants are tabulated, together with appropriate bibliographical listings. Some practical applications of ionizing radiations are also mentioned. 315 references are given. (auth)

1621 INDUCTION OF NUCLEAR DAMAGE BY IONIZING AND ULTRA-VIOLET RADIATION. R. C. von Borstel (Oak Ridge National Lab., Tenn. *and* Università, Pavia, Italy). p.243-50 of "Progress in Photobiology. Proceedings of the 3rd International Congress on Photobiology." Amsterdam, Elsevier Publishing Company.

The study of irradiated, unfertilized *Habrobracon* eggs was combined with the study of irradiated eggs fertilized by unirradiated sperm to detect different kinds of nuclear damage. Damage is used in the sense of induction of death of the cell either immediately after irradiation or after few or many mitoses occur. Types I to V lethality were studied and the probable cause of each was determined. During the study on the comparison of ultraviolet and ionizing radiation effects on the nucleus, it was concluded that ultraviolet radiation has a quantitatively different response than x radiation. Discussion is given on the different effects of the two types of irradiation. (P.C.H.)

1622 MITOTIC EFFECTS OF MONOCHROMATIC ULTRAVIOLET IRRADIATION OF THE NUCLEOLUS. J. Gordon Carlson, Mary Esther Gaulden, and John Jagger (Oak Ridge National Lab., Tenn. *and* Univ. of Tennessee, Knoxville). p.251-3 of "Progress in Photobiology. Proceedings of the 3rd International Congress on Photobiology." Amsterdam, Elsevier Publishing Company.

The effects of different wavelengths of ultraviolet radiation were examined in order to determine whether proteins or nucleic acids were responsible for the mitotic delay induced in different stages of mitosis. Results obtained for each mitotic stage of the irradiated grasshopper embryos and for wavelengths 2650 and 2804 Å are expressed as the time required for the controls to reach metaphase divided by the time required for the treated cells to reach metaphase. For all of the mitotic stages studied prior to early prophase, 2650 Å was more effective than 2804 Å in retarding mitosis. In early prophase, however, there was overlapping of the 70% confidence limits, and middle prophase showed no difference in the efficiencies of the two wavelengths. This suggests either a gradual loss of RNA sensitivity or RNA effectiveness in altering the mitotic rate as prophase progresses. The neuroblast was most sensitive mitotically to 2650 and 2804 Å at middle telophase and very early prophase. It was concluded that the protein rather than the RNA is the effective component of the nucleolus in producing ultraviolet induced acceleration of mitosis. (P.C.H.)

1623 ON THE APPARENT SYNERGISTIC EFFECT OF FAR-RED AND X RAYS IN THE PRODUCTION OF CHROMATID ABERRATIONS. Sheldon Wolff and H. E. Luippold (Oak Ridge National Lab., Tenn.). p.457-60 of "Progress in Photobiology. Proceedings of the 3rd International Congress on Photobiology." Amsterdam, Elsevier Publishing Company.

When lateral roots of Vicia faba are treated with far-red radiation for 3 h after x rays, an apparent potentiation of x-ray-induced genetic damage as measured by chromatid aberrations can be observed. This seems not to be caused by an increase in chromosome breakage or by a decrease in restitution of breaks, but merely by a far-red-induced delay of mitosis. Thus, at any given time after x-ray treatment, different cells will be sampled if far-red is also administered. This can result in a decrease, no effect, or an increase in chromatid aberrations after far-red treatment, depending on the time at which the cells are sampled. Chromosome aberrations that are induced when cells are in a period of uniform sensitivity show no such far-red effects. (auth)

Radiation Sickness

1624 (AF-SAM-61-102) SUBACUTE RADIATION DEATH IN CHEMICALLY PROTECTED MONKEYS. James A. Pitcock and George S. Melville, Jr. (School of Aviation Medicine. Aerospace Medical Center, Brooks AFB, Tex.). May 31, 1961. 6p.

A new mode of death caused by radiation has been characterized in monkeys. Called subacute death, it occurs in animals that would not ordinarily survive 30 days after a supralethal dose of x rays but do so because of protection conferred by chemical treatment prior to irradiation. The syndrome includes lymphocytopenia, usually accompanied by diarrhea. Histologically, atrophy of lymphoid tissue, along with a relatively normal bone marrow, is typically found. The spectrum of other lesions found at death is also different from that found after acute radiation death. (auth)

1625 (JPRS-10248) THE USE OF BONE MARROW TRANSPLANTATION IN THE COMPREHENSIVE TREATMENT OF RADIATION SICKNESS. I. R. Petrov, I. V. Il'inskaya, and T. N. Astakhova. Translated from Vestnik Akad. Med. Nauk S.S.S.R., No. 7, 63-71(July 1961). 16p.

A summary is presented of studies of the prevention of radiation sickness in rats, rabbits, and dogs by the injection of a suspension of bone marrow cells in the bone marrow canal of the femur. Comparative results of investigations are given for the use of bone marrow by intravenous and intramedullary injection. (B.O.G.)

1626 (JPRS-10446) EFFECT OF IONIZING RADIATION ON THE BLOOD LIPID COMPOSITION IN DOGS AND THE ROLE OF HIGHLY UNSATURATED ACIDS DURING THE COURSE OF RADIATION SICKNESS. N. A. Nekovaleva. Translated from Ukrain. Biokhim. Zhur., 33: 348-51(1961). 7p.

Twenty dogs and 10 puppies were irradiated with whole-body x rays to doses of 600 r for dogs and 300 r for the puppies. Blood samples were taken before irradiation and 3, 15, and 21 days after irradiation for lipid analysis. The total number of fatty acids in the blood was somewhat higher after irradiation, and its unsaturated index also increased, while the cholesterol content remained unaltered. Puppies fed with the usual diet showed severe radiation sickness, while puppies fed with a diet including sunflower oil exhibited excellent radiation resistance. (D.L.C.)

1627 OPTIMAL TIME FOR MARROW INJECTION IN MICE AFTER TOTAL BODY IRRADIATION. Bertil Unsgaard (Serafimerlasarettet, Stockholm, Karolinska Institutet, Stockholm, and Research Inst. of National Defence, Sundbyberg, Sweden). Acta Radiol., 56: 296-304(Oct. 1961). (In English)

Mice of the CBA strain, 9 weeks old, were divided in five separate groups and treated with an intraperitoneal infusion of isologous bone marrow at different times after a lethal dose of whole body irradiation. The results show that the optimal time for the infusion of bone marrow is within 24 hours of the irradiation. A certain effect still remains, however, on the 8th day after the dose. (auth)

1628 BEHAVIOR OF THE TRANSFUSED CELLULAR ELEMENTS OF BONE MARROW IN X-IRRADIATED GUINEA-PIGS (ENGLISH TEXT). T. Tamashige (Yamaguchi Prefectural Medical School, Ube, Japan). Bull. Yamaguchi Med. School, 7: 71-90(1959).

A saline suspension of bone marrow from adult guinea pigs was injected intravenously into another adult guinea pig that had been given 550 r of whole-body x irradiation. In order to identify the injuries to the injected cells, the bone marrow elements to be transfused were labeled with radioactive phosphorus. On the 5th day, after transfusion, proliferations of myeloid cells consisting chiefly of erythroblasts were found in the spleen. By the 10th day, myelopoiesis in the spleen and regeneration of bone marrow were extensively seen. In the irradiated animals without transfusion of marrow elements, no hematopoietic recovery in the spleen or in the bone marrow was observed until the 10th day. After transfusion of bone marrow cells, the restoration of erythropoiesis preceded that of granulopoiesis in both spleen and bone marrow of irradiated animals. Ectopic myelopoiesis in the spleen and regeneration of bone marrow were also seen when bone marrow cells of a guinea pig treated by heating at 50°C for 30 min were transfused. In such instances, however, hematopoietic recovery was much less than in the case of transfusion of intact bone marrow. It was concluded that even if the bone marrow were severely injured by radiation, the transfused marrow cells accumulated in the spleen and bone marrow could proliferate. At the same time, proliferation of the transfused marrow cells in the spleen and bone marrow contribute to regeneration of myeloid tissue in x-irradiated animals. (Abstr. Japan Med. 1: No. 12, 1961)

1629 EFFECT OF STRONG MINOPHAGEN C ON RADIATION LEUCOPENIA. I. Momose (Tokyo Univ.). Chiryo, 32: 1439-41(1960).

Five to 20 ml of strong minophagen C, a mixture of aminoacid compounds, were injected intravenously daily into 12 patients with leukopenia (WBC 5000 to 2500) following roentgen irradiation therapy. All cases showed no further decreases in WBC count but rather a tendency to recovery. No decrease of neutrophilic cells was found. In 4 cases, strong minophagen C was effective for radiation disease. (Abstr. Japan Med., 1: No. 12, 1961)

1630 THE INDEPENDENCE OF THE RADIOPROTECTIVE EFFECT OF AMINOETHYLISOTHIURONIUM. Br. HBr OF THE "OXYGEN EFFECT." E. Ya. Graevskii and M. M. Konstantinova (Severtsov Inst. of Animal Morphology, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 705-8(Sept. 21, 1961). (In Russian)

A relatively stable derivative of thiourea, 2-aminoethylisothiuronium (AET). Br. HBr, was used as a protective agent in mice irradiated with single, Co^{60}, gamma doses of 700, 900, and 1200 r. The mice were irradiated in 2.6 liter, glass containers having a controlled oxygen atmosphere of 6.5, 8.2, 21 (air), 50, and 98.2% oxygen diluted with nitrogen. A concentration of 0.5 vol. % CO in air was also used. The percentage of survivals and length of survival were taken as criteria of the protective action of the AET compound. At a dose of 900 r the survival in air alone was zero, while the survival with 0.5% CO in air was 83.2%. The survival with a 10 mg injection of AET in air was 26.0%, and the survival with a 10 mg injection of AET in air having 0.5% CO was 93.5%. These results show that the protective effect of AET in combination with CO exceed the protective effect of CO alone. The survival in an 8.2% O_2 atmosphere was 48.4%, while with an 8.2% O_2 atmosphere plus a 10 mg injection of AET the survival was 78.1%. The controls irradiated in air at 900 r all died in this series of experiments. The protective effect of AET was greater at higher oxygen concentrations. Thus, the survival was only 3.3% at 98.2% O_2, but it was 22.4% at 98.2% O_2 with the injection of 10 mg of AET into the mouse. Polarographic studies showed that the oxygen concentration in the tissues of the mice rose and fell with an increase or decrease of oxygen in the controlled atmosphere. It is concluded that the protective action of AET is independent of the oxygen effect. (TTT)

1631 THE INTRACELLULAR DISTRIBUTION AND BINDING OF RADIATION-PROTECTIVE MERCAPTOALKYLGUANIDINES. Reagan H. Bradford, Raymond Shapira, and David G. Doherty (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 3: 595-608(Nov. 1961). (In English)

Both the tissue distribution and intracellular distribution of mercaptoethylguanidine hydrobromide (MEG), D-mercaptobutyl-2-guanidine hydrobromide (D-MBG-2), and L-mercaptobutyl-2-guanidine hydrobromide (L-MBG-2) were studied in an attempt to determine how these radioprotective compounds may function in vivo. The tissue distributions of all three compounds, which differ by as much as 5 : 1 in their protective activity in mice, were similar, both qualitatively and quantitatively. Their intracellular distribution in mouse liver, rat liver, and rat spleen was selective. Furthermore, a relation between protective activity and intracellular distribution was observed. The intracellular-distribution pattern was altered when the compound was given after irradiation. It is inferred that the microsomal fraction may be involved in radiation death. An investigation of the nature of the binding of each of these compounds to the cellular constituents was made. Dialysis techniques were used in several solvents, including water, denaturants, and oxidizing or reducing agents previously shown to be effective in breaking the disulfide bond. Three general types were found: one relatively loose and similar to enzyme-substrate complexes, a mixed-disulfide binding, and a rather tight binding of unknown nature. A hypothesis is proposed that the protective agent is localized within the cell in such a way that it covers preferentially radiosensitive sites, being held for the most part relatively loosely similar to an enzyme-substrate complex, so that it may effectively quench free radicals formed in the medium. (auth)

1632 THE EFFECT OF CYSTEAMINE ON THE SURVIVAL OF FOETAL GERM CELLS AFTER IRRADIATION. Carol M. Starkie (The University, Birmingham, Eng.). Intern. J. Radiation Biol., 3: 609-17(Nov. 1961). (In English)

The abdomen of pregnant female rats was x irradiated between the 17th and 21st day of gestation with doses ranging between 50 and 150 r. The male offspring were killed 25 days after birth and their testes examined histologically. The results indicate that the extent of testicular damage (proportion of seminiferous tubules classified as normal, regenerating, and sterile) depends both on the dose of irradiation and the foetal age at the time of exposure. Pre-treatment of the pregnant rats with cysteamine shortly before irradiation partially inhibits the deleterious effect of irradiation on the testes of the offspring. (auth)

1633 STIMULATION OF HEMOPOIESIS IN ACUTE RADIATION SICKNESS ACCOMPLISHED BY INTRAVENOUS ADMINISTRATION OF BONE MARROW. L. S. Rogacheva and L. L. Shepshelevich (Central Order of Lenin Inst. of Hematology and Blood Transfusion, USSR). Med. Radiol., 6: No. 10, 52-5(Oct. 1961). (In Russian)

Research covered the effect of homologous bone-marrow tissue injections on the hemopoiesis in acute radiation sickness of dogs subjected to a total irradiation dose of 400 r. A comparison made between the results of this investigation, morphological picture of the bone-marrow, peripheral blood, and the data of the isotope method in treated and control animals gives ground to note the presence of a certain stimulating influence of intravenous injections of the bone marrow on hemopoiesis in irradiated dogs. (auth)

1634 ON THE MECHANISM UNDERLYING DISTURBED FORMATION OF SEROTONIN DURING ACUTE RADIATION SICKNESS. G. A. Chernov and L. M. Morozovskaya (Central Order of Lenin, Inst. of Hematology and Blood Transfusion and Ordzhonikidze Chemical-Pharmaceutical Research Inst., USSR). Med. Radiol., 6: No. 10, 59-62(Oct. 1961). (In Russian)

During experiments on semians, dogs, and guinea pigs evidence on diminished activity of 5-oxytryptophandecarboxylase at late stages of acute radiation sickness was found. The activity level of the enzyme was evaluated on the basis of the increased blood serotonin content on the administration of standard amounts of 5-oxytryptophan at various dates following irradiation.

1635 THE EFFECT OF SULFHYDRYL COMPOUNDS ON THE RADIATION DAMAGE IN CANDIDA BERKHOUT. Armin von Szilvinyi, Uta Rosenkranz, and Helga Manschinger (Hochschule fur Bodenkultür, Vienna). Naturwissenschaften, 48: 533(1961). (In German)

It was established that x and β radiations cause pseudomycellium formation and death in yeast and that these effects can be modified through the use of sulfhydryl compounds. The protective effect of the compounds was measured against a standard compound, thiourea. The protective effects of thiourea against pseudomycellium formation and against death can not be explained by the same mechanism. The results showed that cystein is 24 times more effective against radiation damage than thiourea. It was suggested that the SH compounds which are synthesized in the proteins (cystein) alter the radiosensitivity of the yeast and the compounds which are scavengers (thiourea) prevent the damaging effect. (J.S.R.)

1636 STUDIES ON CHEMICAL PROTECTION AGAINST X-RAY INJURIES. I. EFFECT OF VIT. B_1 AND THIAMINE PROPYL DISULPHIDE (ALINAMIN). T. Hashimoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1119(1959).

F_1 (ddMs x $C_{57}Bl/6$) mice were given x irradiation of 800 r (LD_{100}) and 680 r (LD_{50}) and the protective effect of vit. B_1 and alinamin on the irradiation injuries was observed in mice on a vit. B_1-deficient diet and in those receiving a temporary overdosage of alinamin. Mice of the F_1 strain had the advantages of hereditary homogeneity, prolificity, small dispersion, good growth, and low mortality under various external stresses. A difference in x-ray sensitivity between the two sexes was noted. Mice of the same age must be used for the experiment. Their x-ray sensitivity was increased by vit. B_1 deficiency; this increase was even more marked when a vit. B_1-deficient diet was fed after the irradiation. The protective effect of vit. B_1 depended on the method of administration. In mice given a 2 mg of vit. B_1 after irradiation, the survival rate was 100%. The effectiveness seemed to be due to the supplementation of vit. B_1 destruction, co-carboxylase function, and the supplying of an SH radical in the oxidation-reduction system, which is produced by intrahepatic activation of the S in vit. B_1. X-ray sensitivity was increased in mice receiving a transitory overdose of alinamin. It may be that transformed alinamin increased the indirect action of x-rays, as an oxidizing agent. (Abstr. Japan Med., 1: No. 12, 1961)

1637 TOXICOLOGICAL AND RADIOPROTECTION STUDIES ON S, β-AMINOETHYLISOTHIURONIUM BROMIDE (AET). R. E. Benson, Sol M. Michaelson, W. L. Downs, E. A. Maynard, J. K. Scott, Harold C. Hodge, and Joe W. Howland (Univ. of Rochester School of Medicine and Dentistry, N. Y.). Radiation Research, 15: 561-72(Nov. 1961).

AET was moderately toxic when administered in single doses to mice, rats, rabbits, guinea pigs, and cats. When given by intravenous injection, doses ranging from 50 to 450 mg/kg were lethal; by intraperitoneal injection, the lethal range was 350 to 650 mg/kg. Administered orally as a single dose, the lethal range was 250 to 1000 mg/kg. Rats fed dietary levels of 0.1%, 0.3%, and 0.5% for a period of 1 month showed no effects on growth. A 1.0% dietary level produced a moderate depression of growth. An increase in white cell counts was observed at all dietary levels of AET. No histological lesions were found that could be attributed to the ingestion of AET. The protective effects of S, β-aminoethylisothiuronium · Br · HBr · (AET) against the lethal effects of 594 r of 1-Mev x radiation was tested in 21 dogs, with 14 additional dogs as controls. Data presented indicate failure of this compound to enhance survival or survival rate. (auth)

1638 THE MECHANISM OF ACTION OF AET. III. THE EFFECT OF GAMMA RADIATION ON THE VISCOSITY AND THE ENZYMATIC ACTIVITY OF UREASE SOLUTIONS. E. Anne Dickens and Bernard Shapiro (Albert Einstein Medical Center, Philadelphia). Radiation Research, 15: 594-603(Nov. 1961).

Solutions containing urease, urease and guanidoethyl sulfide $(GES)_2$, and urease-SEG in 0.047 M sodium phosphate buffer at pH 7.5 were given doses of up to 750,000 r with Co^{60} γ rays. The specific viscosity of urease decreases initially and then levels off at about three-fourths the original value. Protection against these irradiation-produced viscosity changes occurs in urease solutions containing $(GES)_2$ but not in solutions containing only urease-SEG. The enzymatic activity of urease solutions decreases as a result of γ radiation. Addition of $(GES)_2$ inhibits the enzyme; however, in solutions containing only urease-SEG, the enzymatic activity is partially restored by γ radiation. Irradiation of solutions of urease containing $(GES)_2$ almost completely destroys the enzymatic activity of these solutions. The viscosity changes in irradiated urease solutions are interpreted as indicating intramolecular rearrangement. Two ways in which $(GES)_2$ could prevent this rearrangement have been indicated. The mechanism of the reactivation of urease-SEG solutions by irradiation is also discussed. (auth)

1639 MODIFICATION OF A SEQUENTIAL PROCEDURE FOR RADIATION PROTECTION STUDIES WITH MICE. John J. Gart (Oak Ridge National Lab., Tenn. and Virginia Polytechnic Inst., Blacksburg). Radiation Research, 15: 616-24(Nov. 1961).

A modification of a previously proposed method of screening compounds for their possible effects against radiation is discussed. A table which facilitates its use is given, together with an approximation which is suggested for group sizes beyond the scope of the table. An illustrative example is given together with its average sample number and OC curves. (auth)

1640 THE EFFECTS OF SOME RADIOPROTECTIVE AGENTS ON THYROID ACTIVITY IN NONIRRADIATED AND X-IRRADIATED RATS. P. V. Vittorio, M. J. Allen, and D. L. Small (Defence Research Board, Radiobiology Lab., Kingston, Ont.). Radiation Research, 15: 625-31 (Nov. 1961).

The effect of the radioprotective agents 2-mercaptoethylamine (MEA), 2-aminoethylisothiouronium · Br · HBr (AET), and 5-hydroxytryptamine (serotonin) on thyroid activity was studied in nonirradiated and x-irradiated rats. In both the nonirradiated and the x-irradiated groups there was a marked difference in the effect produced by serotonin and by the sulfhydryl compounds, MEA and AET. Serotonin appeared to increase whereas MEA or AET decreased I^{131} uptake by the thyroids and by the serum protein-bound iodine. In the x-irradiated sample, serotonin did not markedly increase I^{131} uptake. Initially AET appeared to lower I^{131} uptake slightly more than MEA, but the depressing effects of MEA wore off more quickly than those of AET. In the thyroid and serum protein-bound iodine uptake studies, only in the nonirradiated serum protein-bound I^{131} samples did the mixture of MEA + AET appear to exert a synergistic effect in lowering I^{131} uptake. (auth)

1641 INCREASED RADIORESISTANCE IN MICE INJECTED WITH URETHAN ONE DAY BEFORE X-IRRADIATION. Leonard J. Cole and Steven R. Gospe (U. S. Naval Radiological Defense Lab., San Francisco). Radiation Research, 15: 684-93(Nov. 1961).

Adult female mice received two intraperitoneal injections of aqueous urethan (1 mg/gm of body weight), 1 day apart. Twenty-four hours after the last injection, the mice were exposed to a single acute dose of 250-kv x rays, in the mid-lethal or lethal range. The 30-day LD_{50} for the urethan-treated mice was found to be 970 r; the LD_{100} was 1010 r. The corresponding values for the control irradiated mice were 790 r and 840 r, respectively. The radioprotective effect of urethan was not seen when the drug was administered 30 minutes before irradiation, nor when the mice were irradiated 7 days after the last urethan injection. The protective effect could not be duplicated by preirradiation exposure (1 or 2 days prior) to 100 r, 200 r, or 300 r. Nonirradiated mice given two daily injections of urethan as above exhibited a marked fall within 24 hours, in the total nucleated cell count of femoral marrow and peripheral blood, accompanied by a definite increase in the myeloid/lymphoid cell ratio of the blood. The results suggest that urethan-induced alterations in cell population of bone marrow are accompanied by an increase in the number of relatively radioresistant cell types, involved in myelopoiesis. (auth)

1642 EFFECT OF L-TRIIODOTHYRONINE ON POST-IRRADIATION FIBROSIS. Arvin S. Glicksman, Toshio Kitagawa, Ralston R. Fillmore, and James J. Nickson (Memorial Hospital, New York and Sloan Kettering Inst., New York). Radiology, 77: 799-803(Nov. 1961).

The results of experiments on rats indicate that exposure to ionizing radiation accelerates the rate of accumulation of collagen in skin and subcutaneous tissue. Administration of the thyroid analog L-triiodothyronine, beginning 8 weeks after exposure of a limb to 3,000 rads x radiation, greatly decreased the deposition of collagen. It is concluded that results support the concept that radiation injuries exist in a dynamic state and that modification is possible by alteration of the metabolism of the damaged tissues. (C.H.)

1643 CREATINURIA AND FATIGUE IN PATIENTS UNDERGOING RADIATION THERAPY. Samuel S. Kurohara, Philip Rubin, and Louis H. Hempelmann (Univ. of Rochester, N. Y.). Radiology, 77: 804-12(Nov. 1961).

The 24-hour urinary creatine levels were measured at daily to weekly intervals in 35 patients who were treated for various types of malignant disease. The degree of creatinuria appeared to be related to the severity of fatigue symptoms, tissue integral dose, the sex of the patient, and the anatomical site of irradiation. The greatest increases in the creatine coefficient values were found during the course of irradiation in female patients who received radiation therapy to the pelvis. This appeared to be related to the integral dose and the treatment time in which the radiation was absorbed. The male patients who received pelvic irradiation did not show any significant degree of creatinuria or fatigue symptoms. The patients who received relatively large volume doses to the thorax showed a significant degree of creatinuria and fatigue. The fatigue symptomatology and the degree of creatinuria appeared roughly to parallel each other. The most severe fatigue symptoms occurred at the height of creatinuria or just following it. The female patients who received radiation to the pelvis suffered more fatigue than the patients who received radiation to the abdomen, thorax, or head and neck region. The need for redefinition of clinical radiation sickness into gastrointestinal symptoms and muscular fatigue is emphasized. Various possible mechanisms of creatinuria are discussed. (auth)

1644 QUANTITATIVE RELATIONSHIPS BETWEEN RADIATION DOSE AND THE REPRODUCTIVE CAPACITY OF TUMOR CELLS IN A MAMMALIAN SYSTEM IN VIVO. Roger J. Berry and J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Radiology, 77: 824-30(Nov. 1961).

A quantitative system for the determination of relationships between radiation dose and the reproductive capacity of tumor cells has been developed with use of the ascites form of a transplantable mouse lymphocytic leukemia. The system offers freedom from host-immunity factors and provides a method for studying changes in radiosensitivity related to alteration in oxygen tension, ionization density of the radiation (LET), or as induced by pharmacological agents. The method is important because it permits the study of these effects and of dose fractionation in the intact mammal rather than in free cell culture or simpler biological systems. Application to radiotherapy is discussed. (auth)

1645 THE QUESTION OF THE DIETARY MODIFICATION OF RADIATION SICKNESS. Vladimir Hrstka (Inst. of Public Health, Bratislava). Strahlentherapie, 115: 622-8(Aug. 1961). (In German)

It was found that the administration of fructose leads to a considerable improvement in the hemoglobin content during the course of radiation sickness. Fochem's discovery on the favorable action of fructose could be confirmed. The administration of glucose and saccharose had little essential influence upon the course of radiation sickness. (auth)

CHEMISTRY

General and Miscellaneous

1646 (61-RL-2634M) A SURVEY OF OXYGEN BINARY SYSTEMS. I. RARE EARTH METAL-OXYGEN SYSTEMS. J. H. Westbrook, R. E. Carter, and R. C. DeVries (General Electric Co. Research Lab., Schenectady, N. Y.). Jan. 31, 1961. 43p.

A literature survey of the binary rare earth metal-oxygen systems was made. Information was selected with the aim of drawing binary metal-oxygen diagrams, and such diagrams have been included where sufficient information exists. (auth)

1647 (IS-339) REDUCTION OF NIOBIUM PENTOXIDE BY CARBON. Ernest Roger Stevens and H. A. Wilhelm (Ames Lab., Ames, Iowa). Feb. 1961. Contract W-7405-Eng-82. 54p.

The investigations of the reduction of niobium pentoxide by carbon showed that niobium metal could be prepared by a direct reduction. High temperatures in the region of 2000°C but below the melting point of niobium and dynamic vacuum of one micron or less were the principal experimental conditions employed throughout the course of this study. The reaction, which followed very closely the stoichiometry of the equation $Nb_2O_5 + 5C \rightarrow 2Nb + 5CO$, began at a temperature near 1200°C and was nearly completed at 1600°C. The data indicated that it might be possible to allow reduction to take place at approximately 1800°C. After the reaction is completed at this temperature, raising of the temperature of the reaction material to nearly 2000°C might eliminate residual oxygen as a result of volatilization of a lower oxide of niobium. If, then a larger scale preparation could be derived from this work, such a process would eliminate various intermediate steps in the usual industrial production of niobium metal. A simple direct reduction below the melting point of niobium and subsequent arc melting of the metal to give a massive, good quality product might prove to be an economical process for the production of niobium. (auth)

1648 (NAA-SR-6420) BERYLLIUM OXIDE SINGLE CRYSTAL GROWTH. II. WATER VAPOR TRANSPORT METHOD. S. B. Austerman and A. R. Hopkins (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1961. Contract AT(11-1)-GEN-8. 20p.

Beryllium oxide single crystals were grown by a method employing a reversible reaction between BeO and water vapor at high temperature. The reaction product, $Be(OH)_2$, was formed at temperatures between 1300 and 1650°C, then was allowed to decompose to BeO and H_2O at a temperature several hundred degrees lower. Single crystals of simple and complex forms were formed. The principal interference with growth of large well-formed crystals was found to be impurities derived from the furnace, water, and the nutrient BeO placed in the furnace. Crystal growth mechanisms probably involved various types and orientations of dislocation structures, impurity poisoning of growth steps, spurious nucleation of new orientations by impurities, and diffusion-limited or -controlled nutrition of the growing crystals. By suitable control of purity of the crystal growth system, crystals of size 5 mm dia × 1 mm thickness as platelets or 2 cm × 2 mm diameter as rods were produced. (auth)

1649 (ORNL-TM-1) QUARTERLY PROGRESS REPORT FOR CHEMICAL DEVELOPMENT SECTION B, APRIL–JUNE 1961. R. E. Blanco (Oak Ridge National Lab., Tenn.). Nov. 15, 1961. Contract [W-7405-Eng-26]. 92p.

Progress is reported on research on graphite fuels, UC, Be and BeO, volatilization of chlorides with H_2O_2, acid thorex process, extraction of U from Zr fuel solutions, extraction of Nb with TBP, separation of Th from U^{233} by ion exchange, IMMI mixer-settler studies, corrosion studies, radiation damage to TBP-Amsco 125-82 systems, foam separation, distribution of HNO_3 between aqueous and TBP-Amsco 125-82 solutions, vapor pressure of TBP, waste fixation in borate and phosphate glasses, low-level waste treatment, fission product recovery by ion exchange, radiation damage to ion exchange resins, diffusion-controlled exchange of tritium, and plasma jet experiments. (M.C.G.)

1650 (TID-13811) THE SEPARATION OF DIASTEREOISOMERIC CYSTATHIONINES. Joseph R. Riden, Jr. and Robert Ballentine (Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.). [Sept. 29, 1961]. Contract AT(30-1)-933. 5p.

A method is reported for separation of isomeric cystathionines via their benzoylated derivatives. (J.R.D.)

1651 (TID-14260) SYNTHESIS OF ORGANOMETALLIC COMPOUNDS OF THE LANTHANIDE AND ACTINIDE SERIES. Third Quarterly Report, November 15, 1961. [Ethyl Corp., New York]. Contract AT(11-1)-999. 6p.

The dicyclopentadienyl monochloride derivatives of gadolinium, erbium, and ytterbium were prepared by reaction of two equivalents of cyclopentadienylsodium with one equivalent of the respective trichlorides. The same complexes of gadolinium, erbium, and ytterbium were also prepared by disproportionating the trichlorides with their respective tricyclopentadienyl derivatives. Attempted preparations of the dicyclopentadienyl monochloride derivatives of the lower members of the lanthanide series, lanthanum, cerium, praseodymium, and neodymium, were not successful with either of the above procedures. (auth)

1652 (AEC-tr-4862) THE HEATS OF FORMATION OF TITANIUM SILICIDES. Yu. M. Golutvin. Translated by Lydia Venters (Argonne National Lab., Ill.) from Zhur. Fiz. Khim., 30: 2251(1956). 13p.

The heats of combustion of Ti, Si, $TiSi_2$, and Ti_5Si_3 were determined in a bomb. The heats of formation at 298°K were calculated to be -42.9 ± 4.5 kcal/mole for $TiSi_2$, -39.2 ± 3.0 kcal/mole for TiSi, and -147 ± 12 kcal/mole for Ti_5Si_3. (D.L.C.)

1653 (AEC-tr-4868) INVESTIGATION OF THE CHLORINATION OF NIOBIUM PENTOXIDE AND ZIRCONIUM DIOXIDE. I. S. Morozov and B. G. Korshunov. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Khim. Redkikh Elementov, Akad. Nauk S.S.S.R., Inst. Obshchei i Neorg. Khim., No. 2, 102-14(1955). 17p.

The chlorination reaction of niobium pentoxide was investigated from 700 to 1100°. The vapor pressure of niobium oxychloride and its stability were determined. The equilibrium constant of the reaction $2Nb_2O_5 + 6Cl_2 \rightleftharpoons 4NbOCl_3 + 3O_2$ and the change in the standard free energy were determined at 800, 900, 1000, and 1100°C. The chlorination reaction of ZrO_2 was determined from 1000 to 1200°C. The equilibrium constant of the reaction $ZrO_2 + 2Cl_2 \rightleftharpoons ZrCl_4 + O_2$ and the change in the standard free energy at 1000, 1100, and 1200°C were determined. (auth)

1654 (UCRL-Trans-696) CONCENTRATION DEPENDENCE OF ACTIVITY OF FERMENTS IN CONNECTION WITH THEIR BEHAVIOR IN COACERVATES. V. P. Slobodskaia and A. G. Pasynskii. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Doklady Akad. Nauk S.S.S.R., 137: 715-18 (1961). 8p.

Studies were conducted of the course of fermentative reactions of β-amylase and peroxidase in a 50 to 100-fold concentration interval. In the systems investigated no intensification of the fermentative activity was observed with the concentration of the ferment. The linear dependence in the 100-fold interval of concentration for β-amylase is considered to be important in connection with the behavior of ferments in coacervates. (B.O.G.)

1655 (UCRL-Trans-727(L)) STANDARD VIBRATIONS OF HYDRAZINE. Akiko Yamaguchi, Bunkyo Ku, Tokai Mura, and Naka Gun. Translated for Univ. of California Lawrence Radiation Lab., Livermore from Nippon Kagaku Zasshi, 80: 1109-12(1959). 14p.

In order to examine the nature of the characteristic vibrations of the non-plane type NH_2 radicals, calculations of the standard vibrations of hydrazine were carried out and the groupings of the absorption bands clarified. The accuracy of the groupings on the basis of the distribution of potential energy was confirmed by a measurement of the infrared absorption of the liquid and the Raman effects. The range of the frequencies of the vibrations of the non-plane type radical and their vibration types are described. (auth)

1656 THE THERMODYNAMICS OF THE REDUCTION OF URANIUM TETRAFLUORIDE BY CALCIUM. N. P. Galkin, U. D. Varyatin, and Yu. V. Smirnov. Atomnaya Energ., 11: 247-60(Sept. 1961). (In Russian)

In view of the importance of the reduction of UF_4 by Ca and Mg for the preparation of metallic U, the thermodynamic calculations on the $UF_4 + 2Ca = U + 2CaF_2 + Q$ reaction were compared with previously published data on the reduction of UF_4 with Mg. The plot of the heat effect of the free energy of the reaction and of the logarithm of the equilibrium constant vs. the temperature showed that from the boiling point of the UF_4 the heat effect decreases sharply. The theoretical reduction temperature was calculated at 2100°C while experimental work with W–Mo thermocouples indicated a temperature of 2000°C which is higher than the melting point of the slag. The heat liberated is thus sufficient to melt the reaction products and accordingly calciothermic reduction does not require preheating which is necessary for the reaction with Mg. In view of the lower vapor pressure of Ca with respect to Mg, the reduction may be carried out in an open apparatus. The free energy and the equilibrium constant decrease with increasing temperature while the equilibrium shifts toward the formation of $U + CaF_2$. The calculations thus indicate that the use of Ca is preferable to Mg; the continued use of the latter abroad is due to its lower price. (TTT)

1657 THE INTERACTION OF RHENIUM HEXAFLUORIDE WITH METALLIC FLORIDES. N. S. Nikolaev and E. G. Ippolitov. Doklady Akad. Nauk S.S.S.R., 140: 129-32(Sept. 1, 1961). (In Russian)

ReF_6 was prepared by burning Re metal in a current of trifluorochlorine, and by reacting Re metal with fluorine at 150°C in a nickel reactor. The reaction of ReF_6 with alkali metal fluorides was studied at 200°C in a teflon autoclave. The reaction goes in two stages: 1) $ReF_6 + 2MeF = Me_2ReF_8$, and 2) $Me_2ReF_8 + ReF_6 \rightleftharpoons 2MeReF_7$, where Me is Na, K, Rb, or Cs. Reaction 2) occurs at lower temperatures. The thermal stability of the pentafluororhenates decreases according to the following series: Cs > Rb > K > Na. In general, the sodium salt can not be prepared, while the potassium salt starts to dissociate at 50°C according to equation (2). The $KReF_7$ salt breaks down rapidly at 200 to 300°C, and forms ReF_6 and K_2ReF_8. The thermal stability of K_2ReF_8 is surprising. Only a slight loss in weight is observed at 700°C. $RbReF_7$ and $CsReF_7$ react with the corresponding alkali metal fluoride to form the octafluororhenate salt. The x-ray spectra of the sodium, potassium and rubidium octafluororhenates were obtained on an ionization chamber. The density of potassium octafluororhenate was 4.35 g/cm^3. The magnetic moment of all the octafluororhenates is 1.6 to 1.7 μ_B, a value in agreement with the hexavalent state of rhenium. All the octafluororhenates, except the sodium salt, are almost insoluble in water, and impart a blue color to the solution on standing. All the heptafluororhenates are readily soluble in cold water with the formation of blue solutions analogous to those obtained from the octafluororhenates. (TTT)

1658 A COMPLEX URANYL DICARBONATE. D. I. Ryabchikov and E. K. Korchemnaya. Doklady Akad. Nauk S.S.S.R., 140: 605-6(Sept. 21, 1961). (In Russian)

Carbonate reacts with uranyl ion to form tricarbonate compounds of the form $Me_4[UO_2(CO_3)_3]$. A bicarbonate complex was obtained by adding solid sodium bicarbonate in portions to a uranyl nitrate solution. After the precipitate that is first formed just redissolves, alcohol is added to the aqueous solution to give a crop of fine crystals. Chemical analysis showed that the composition of the crystals could be expressed by the formula $Na_2[UO_2(CO_3)_2(H_2O)_2]$. The reaction between uranyl nitrate and sodium bicarbonate goes as follows: $UO_2(NO_3)_2 + 4NaHCO_3 \rightarrow Na_2[UO_2(CO_3)_2(H_2O)_2] + 2NaNO_3 + 2CO_2$. The solubility of sodium uranyl dicarbonate is about 5 times greater than that of sodium uranyltricarbonate. An aqueous solution of the freshly-prepared aquo complex shows a weakly acidic reaction. It can be assumed that the aqueous form of the dicarbonate complex reacts by internal dissociation: $Na_2[UO_2(CO_3)_2(H_2O)_2] \rightleftharpoons Na_2[UO_2(CO_3)_2(H_2O)(OH)]$ is formed in solution, and can be detected by titration with caustic. (TTT)

1659 MALONATE AS A BRIDGING GROUP FOR ELECTRON TRANSFER. George Svatos and Henry Taube (Chicago Univ.). J. Am. Chem. Soc., 83: 4172-5(Oct. 20, 1961).

When malonate is the bridging group in the reaction of acid malonatopentamminecobalt(III) ion with Cr^{2+}, a term in the rate law first order in (H^+) is observed in addition to the acid independent term and the term inverse in (H^+). The term first order in (H^+) is absent when the methylene hydrogens are replaced by C_2H_5. This and other observations suggest that the acid dependent term involves dissociation of a methylene hydrogen under the combined influence of acid and the reducing agent, the resulting system of delocalized electrons serving to conduct the electron from Cr^{2+} to the Co(III) center. (auth)

1660 EVIDENCE FOR EXCHANGEABLE HYDROGEN IN CHLOROPHYLL. J. J. Katz, M. R. Thomas, H. L. Crespi, and H. H. Strain (Argonne National Lab., Ill.). J. Am. Chem. Soc., 83: 4180-2(Oct. 20, 1961).

Both chlorophylls a and b undergo slow exchange of hydrogen with methanol in carbon tetrachloride solution. Both compounds possess one enolizable (or exchangeable) hydrogen atom and exist predominantly in the keto form. (auth)

1661 THE CONCURRENT ALKALINE HYDROLYSIS AND ISOTOPIC OXYGEN EXCHANGE OF A SERIES OF p-SUBSTITUTED ACETANILIDES. Myron L. Bender and Robert J. Thomas (Illinois Inst. of Tech., Chicago and Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 83: 4183-9(Oct. 20, 1961).

The kinetics of the concurrent alkaline hydrolysis and carbonyl oxygen exchange of a series of p-substituted acetanilides were investigated. The kinetics of hydrolysis are complicated, involving terms both first and second order in hydroxide ion. Significant carbonyl oxygen exchange occurred under conditions in which 90% of the reaction proceeded via a process first order in hydroxide ion. The effect of substituents on the over-all hydrolytic rate constant was small. From the hydrolysis and oxygen exchange data, the effects of substituents on k_1, the formation of the tetrahedral intermediate, and on k_3/k_2, the partitioning of the intermediate to products and reactants, were determined. Electron-withdrawing substituents increased $k_1(\rho + 1.0)$ and decreased $k_3/k_2(\rho - 1.0)$, leading to an over-all cancellation of substituent effects (ρ of $k_h = +0.1$). On the basis of the substituent effect on k_3/k_2, it was postulated that the breakdown of the tetrahedral addition intermediate to give products must involve the formation of the dipolar ion, $CH_3C(O^-)_2NH_2^+C_6H_4X$. This phenomenon was thought to be a general property of amide hydrolyses and other hydrolyses where a negative leaving group would involve a species of very high basicity. (auth)

1662 THE CONCURRENT ALKALINE HYDROLYSIS AND ISOTOPIC OXYGEN EXCHANGE OF A SERIES OF p-SUBSTITUTED METHYL BENZOATES. Myron L. Bender and Robert J. Thomas (Illinois Inst. of Tech., Chicago and Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 83: 4189-93(Oct. 20, 1961).

The kinetics of the concurrent alkaline hydrolysis and isotopic oxygen exchange of five p-substituted methyl benzoates were determined in 33⅓% dioxane-water. The kinetics of hydrolysis precisely obeyed a Hammett relationship with a rho of +1.93. Contrary to predictions based on the previous mechanism of concurrent hydrolysis and exchange, the p-substituent had a large effect on the ratio k_h/k_{ex}, which varied from 30 for the p-NH_2 ester to 2.8 for the p-NO_2 ester. This result was rationalized by assuming that the proton transfers in the tetrahedral intermediate, which must take place to make the two oxygen atoms equivalent to one another and thus which must take place for exchange to occur, are kinetically significant with respect to the decomposition of the intermediate to products. Estimates of the rates of these two processes indicated that this is a reasonable assumption, and that the previous hypothesis that proton transfer was kinetically insignificant may be incorrect. (auth)

1663 THE CONCURRENT ALKALINE HYDROLYSIS AND ISOTOPIC OXYGEN EXCHANGE OF SEVERAL ALKYL BENZOATES AND LACTONES. Myron L. Bender, Hideo Matsui, Robert J. Thomas, and Stephen W. Tobey (Illinois Inst. of Tech., Chicago and Northwestern Univ., Evanston, Ill.). J. Am. Chem. Soc., 83: 4193-6(Oct. 20, 1961).

The kinetics of the concurrent alkaline hydrolysis and isotopic oxygen exchange of methyl benzoate, p-chlorobenzyl benzoate, p-methoxybenzyl benzoate, phthalide, and γ-butyrolactone were determined. Only in the hydrolysis of methyl benzoate was concurrent oxygen exchange found. In the other hydrolyses, the exchange reaction was not present within experimental error. A lower limit of the ratio k_h/k_{ex} in the latter reactions was calculated. The lack of oxygen exchange in the hydrolysis of the benzyl benzoates, as contrasted to that of the kinetically similar methyl benzoate, is attributed to the preferential partitioning of the tetrahedral intermediate to products to relieve steric strain in the intermediate caused by the bulky benzyloxy group. (auth)

1664 MOLECULAR REARRANGEMENTS. XIX. THE THERMAL DECOMPOSITION OF N-ACETYL-N-NITROSO-1,2,2-TRIPHENYLETHYLAMINE. Clair J. Collins, Joan B. Christie, and Vernon F. Raaen (Oak Ridge National Lab., Tenn. and Univ. of Florida, Gainesville). J. Am. Chem. Soc., 83: 4267-74(Oct. 20, 1961).

Several isotope position isomers of N-acetyl-N-nitroso-1,2,2-triphenylethylamine(III) were prepared in optically active form. The thermal decompositions of these in p-cymene and in glacial acetic acid at several temperatures were followed kinetically. The product, partially racemic 1,2,2-triphenylethyl acetate(IV), was resolved, and the C^{14} distributions in each enantiomer were determined. The nitrosoamide IIIa, labeled in the 1-position with C^{14} was subjected to thermal decomposition also in propionic acid, and the yields of acetate IV and propionate VI were determined. Both exhibited scrambling of their chain labels. The identification of labeled acetoxyl with D-(+)-1,2,2-triphenylethyl acetate(IVc) in the thermal decomposition of (−)-IIIc in glacial acetic acid established the D-configurations of (+)-I, (+)-II, and (−)-III. Optically active 1,2,2-triphenylethyl-1-C^{14}-amine (Ia) was deaminated in glacial acetic acid containing sodium acetate, the partially racemic product IVab was resolved and the C^{14} distribution in each enantiomer was determined. The extent of inversion during each reaction was measured. All results are explained in terms of a mechanism involving ion pairs of the acetoxyl anion with equilibrating, classical triphenylethyl carbonium ions. (auth)

1665 DISTRIBUTION OF RADIOACTIVITY IN MORPHINE FROM BIOSYNTHESIS WITH CARBON-14 DIOXIDE. Henry Rapoport, Naomi Levy, and Frank R. Stermitz (Univ. of California, Berkeley). J. Am. Chem. Soc., 83: 4298-4300(Oct. 20, 1961). (UCRL-9848)

Morphine isolated from each of two separate $C^{14}O_2$-biosyntheses was diluted and degraded to give various activities in dpm/u mole of diluted material. The total activities per biogenetic unit were found not to have a 1:1 ratio as was previously reported. It was concluded that the hydrophenanthrene ring structure cannot be formed by the combination of two identical molecules and that a symmetrical intermediate is not involved. (M.C.G.)

1666 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. VOLUME 3. H. J. Emeléus and A. G. Sharpe, eds. New York, Academic Press Inc., 1961. 469p. $12.50.

Advances in chemistry are reviewed in eight papers. Three separate abstracts were prepared. Topics not covered in separate abstracts include the following: molecular complexes of halogens; structures of interhalogen compounds and polyhalides; silanes and their derivatives; the general, selective, and specific formation of complexes by metallic cations; and polyfluoroalkyl derivatives of metalloids and nonmetals. (M.C.G.)

1667 MECHANISMS OF SUBSTITUTION REACTIONS OF METAL COMPLEXES. Fred Basolo and Ralph G. Pearson (Northwestern Univ., Evanston, Ill.). p.1-89 of "Advances in Inorganic Chemistry and Radiochemistry. Volume 3." New York, Academic Press Inc., 1961.

Recent studies of mechanisms of substitution reactions of metal complexes are summarized. Acid hydrolysis, base hydrolysis reactions in nonaqueous solvents, and stereochemistry of octahedral complexes are described. Solvent effect, steric effect, trans-effect, effect of ligand and its replacement, and effect of metal ion in square complexes are outlined. Also discussed are tetrahedral complexes, fast reactions, metal carbonyls, and photochemistry of metal complexes. (M.C.G.)

1668 RARE EARTH RESEARCH. Eugene V. Kleber, ed. Based on A Seminar at Lake Arrowhead, California, October, 1960. New York, The Macmillan Company, 1961. 318p. $9.75.

Information is presented in five selected areas of rare earth research. It is based on a seminar at Lake Arrowhead, California. Separate abstracts were prepared for 29 of the papers. The remaining 4 were previously abstracted in NSA. (M.C.G.)

1669 SOME ASPECTS OF THE STABILITIES OF AMINE POLYCARBOXYLIC ACID CHELATES OF THE TRI-POSITIVE RARE EARTH METAL IONS. Therald Moeller, Larry C. Thompson, and Ricardo Ferrus (Univ. of Illinois, Urbana). p.3-11 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Data are summarized indicating that the rare earths are readily oxidized to the tri-positive ions. The stabilities of amine polycarboxylic acid chelates of these ions were investigated. Electrostatic, steric, and ligand-field interpretations of the observed variations in stability are discussed. (M.C.G.)

1670 FORMATION CONSTANTS AND MAGNETIC BEHAVIOR OF SOME RARE EARTH CHELATES. Ingmar Grenthe and W. Conrad Fernelius (Univ. of Lund, Sweden and Koppers Co., Inc., Pittsburgh). p.12-25 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The formation constants of complexes of rare earths with acetylacetone and dipicolinic acid were determined. Logarithms of the formation constant were plotted as a function of ionic potential. For lanthanum to europium the increase was almost linear, while for gadolinium to lutetium the value remained almost constant. A study was also made to determine if the magnetic properties of the rare earth ion were influenced by the character of the coordinated ligands. (M.C.G.)

1671 SOME OBSERVATIONS REGARDING RARE EARTH GLYCOLATES. J. E. Powell and J. L. Farrell (Ames Lab., Ames, Iowa). p.26-30 of "Rare Earth Research." New York, The Macmillan Company, 1961.

It appeared that precipitation as hydrated glycolates would be useful for separating yttrium-group elements from cerium-group rare earths. Light rare earths apparently did not form glycolate dihydrates, but separated instead as anhydrous glycolates which form more slowly than dihydrated glycolates of the yttrium-group rare earths. The change in hydration occurred at gadolinium which can form either the anhydrous glycolate or the dihydrate. A change in chelate stability also occurred at gadolinium. These phenomena were apparently related. (auth)

1672 THE USE OF ZINC AND HYDROGEN IONS IN THE DEVELOPMENT COLUMNS IN THE SEPARATION OF CERIUM-GROUP RARE EARTHS BY ION-EXCHANGE ELUTION. Jack E. Powell (Iowa State Univ. of Science and Tech., Ames). p.31-6 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The use of zinc as the retaining ion in the separation of cerium-group rare earths by ion exchange elution with EDTA is discussed. A series of elutions were performed in order to prove that the zinc eluate could be reused as the retaining ion. It was also confirmed that about 42% of the EDTA required in the separation of a mixture of this sort could be recovered from the zinc laden eluate by acidification followed at a suitable interval by filtration. A procedure for processing mixtures containing substantial amounts of heavy rare earths is outlined. (M.C.G.)

1673 LIQUID-LIQUID EXTRACTION OF TRIVALENT RARE EARTHS USING ACIDIC PHOSPHONATES AS EXTRACTANTS. D. F. Peppard and G. W. Mason (Argonne National Lab., Ill.). p.37-50 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The application of liquid-liquid extraction techniques to the fractionation of mixtures of trivalent rare earths is discussed. Acidic phosphonates were used as the extractants. The degree of fractionation per equilibrium stage for a given pair of rare earth elements was calculated. The "homogeneous" phosphonate was found to be a less effective extractant than the corresponding ortho phosphate. (M.C.G.)

1674 SOME ELECTROCHEMICAL DIFFERENCES OF THE LANTHANONS AS RELATED TO THEIR SEPARABILITY AT AMALGAM CATHODES. E. I. Instott (Los Alamos Scientific Lab., N. Mex.). p.51-7 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The electrochemical behavior of lanthanons with valances of (III) or lower is described. The classical electrode potentials and electrode mechanisms are discussed. The group difference between the (III) lanthanons and Sm, Eu, and Yb in the metallic phase was studied. The amalgam cathode as a separation tool is discussed. The steady-state electrolysis of mixtures of lanthanons at a lithium amalgam cathode was investigated. (M.C.G.)

1675 TETRAVALENT NEODYMIUM AND DYSPROSIUM. L. B. Asprey (Los Alamos Scientific Lab., N. Mex.). p.58-65 of "Rare Earth Research." New York. The Macmillan Company, 1961.

Evidence for the existence of both Nd(IV) and Dy(IV) as double fluorides of cesium or bubidium, with at least two atoms of alkali per lanthanide, is presented. The compounds containing the tetravalent ions were prepared by treating mixtures of the alkali-lanthanide chlorides with elemental fluorine at temperatures between 100 and 400°C. Results of spectral data, chemical analysis, magnetic susceptibility measurements, and x-ray structure measurements indicated the presence of tetravalent ions. (M.C.G.)

1676 STRUCTURE AND MAGNETIC PROPERTIES OF PEROVSKITES. Aaron Wold (Massachusetts Inst. of Tech., Cambridge). p.81-7 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The principal effects responsible for the crystal structure of rare earth-transition-metal perovskites (ABO_3), ionic size and electronic ordering, are discussed. The further relationship between these two effects and the magnetic properties of several perovskite systems is described. (M.C.G.)

1677 PHASE-EQUILIBRIA RESEARCH IN SYSTEMS INVOLVING THE RARE EARTH OXIDES. Robert S. Roth (National Bureau of Standards, Washington, D. C.). p.88-95 of "Rare Earth Research." New York, The Macmillan Company, 1961.

A review is presented of phase-equilibria research on systems involving rare earth oxides with oxides of other trivalent ions, Nb_2O_5 or Ta_2O_5, and B_2O_3. (M.C.G.)

1678 THE INFLUENCE OF TEMPERATURE ON THE CERIUM OXIDE SYSTEM, $CeO_2-Ce_2O_3$. Georg Brauer and Karl Gingerich (Universität, Freiburg i. B. and Pennsylvania State Univ., University Park). p.96-104 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The influence of temperature on the cerium oxide system was investigated by measuring the oxygen dissociation pressures in the region $CeO_{2.0}-CeO_{1.5}$, and by high temperature x-ray powder-diffraction analysis in the region $CeO_{2.0}-CeO_{1.8}$ for a temperature range of 20 to 1050°C. Thermodynamic properties such as partial molar heats, free energies, and entropies of formation were derived from the equilibrium pressures. All phase changes were found to occur very rapidly. A continuous solid solution with defective fluorite structure existed at higher temperatures. The influence of temperature on the crystal-chemical behavior of the entire system was determined and compared with that of the praseodymium oxides. (auth)

1679 OXYGEN POSITIONS IN RARE EARTH-IRON GARNETS AND THEIR IMPLICATIONS. Ernst R. Czerlinsky and Ferdinand Euler (Air Force Cambridge Research Labs., Cambridge, Mass.). p.113-18 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The positions of oxygen ions in the cell structure of rare earth-iron garnets were investigated. The effects of the shape of the configuration of oxygen ions on the magnetic interaction between the ferric ions were also studied. The nonzero-layer reflections were determined for the garnet crystals. (M.C.G.)

1680 HIGH-TEMPERATURE OXIDATION OF RARE EARTH METALS. Karl S. Vorres and LeRoy Eyring (Univ. of Miami, Coral Gables, Fla. and State Univ. of Iowa, Iowa City). p.119-23 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The kinetics of high-temperature oxidation of rare earths were studied. Two methods were used to determine the oxidation rate constants at different temperatures. The experiments were carried out with these metals in a stream of oxygen in a recording thermobalance with a chemical regulator. All the rare earth metals obeyed a parabolic oxidation law. Oxygen diffusion through the oxide film appeared to be the mechanism involved in all the reactions. (M.C.G.)

1681 CELL DIMENSIONS AND MAGNETICAL SUSCEPTIBILITIES OF THE MX COMPOUNDS OF RARE EARTHS WITH P, As, Sb, Bi, S, Se, AND Te. A. Iandelli (Università, Genoa). p.135-41 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Data were obtained on compounds of the general formula MX which the rar earths make by reacting with metalloids of the 5th and 6th group of the periodic system. The compounds were prepared by direct reaction between the two elements. Cell dimensions and magnetic susceptibilities were determined. (M.C.G.)

1682 MAGNETIC AND ELECTRICAL PROPERTIES OF RARE EARTH METAL SINGLE CRYSTALS. Sam Legvold (Iowa State Univ. of Science and Tech., Ames). p.142-8 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Single crystals of rare earth metals were prepared by polishing arc-melted buttons and annealing for several hours at a temperature about 150° below the melting point. The magnetic and electrical properties of single crystals of dysprosium, erbium, and holmium were determined. (M.C.G.)

1683 ELECTRICAL AND MAGNETIC PROPERTIES OF THE RARE EARTH METALS AND THEIR ALLOYS AND COMPOUNDS. K. A. Gschneidner, Jr., and B. T. Matthias (Los Alamos Scientific Lab., N. Mex. and Bell Telephone Labs., Inc., Murray Hill, N. J.). p.158-64 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The existence of ferromagnetism and of superconductivity in the pure Group IIIA rare earth metals appeared to be related to the crystal structure of the metals. The superconducting and ferromagnetic behavior of any one of these metals became predictable when the differences in crystal structure are eliminated by alloying or by forming compounds. (auth)

1684 SATURATION MAGNETIZATION, INTERATOMIC INTERACTIONS AND REMANENCE OF SOME RARE EARTH METALS AND COMPOUNDS. Warren E. Henry (Lockheed Missiles and Space Div., Palo Alto, Calif.). p.165-77 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Studies were made of the rare earth metals Ce, Pr, Nd, Gd, Th, Dy, Ho, and Tm and the compounds Yb_2O_3, Nd_2O $Gd_2(SO_4)_3 \cdot 8H_2O$, UH_3, UD_3, and UO_2. Analysis of the data from magnetization studies indicated that the magnetization, as a function of field and temperature, can be predicted on the basis of spectroscopically determined magnetic atomic constants for the S-states and for magnetically dilute assemblies. The saturation magnetization could be predicted for the S-state even if there was ferromagnetic interaction. (M.C.G.)

1685 MAGNETIC STRUCTURE PROPERTIES OF RARE EARTH METALS. W. C. Koehler, E. O. Wollan, M. K. Wilkinson, and J. W. Cable (Oak Ridge National Lab., Tenn.). p.149-57 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Neutron diffraction studies were made of the magnetic structure properties of Tb, Dy, Ho, Er, and Tm at various temperatures and under varying conditions of application of an external magnetic field. (M.C.G.)

1686 PARAMAGNETISM OF POLYCRYSTALLINE RARE EARTH METALS. Sigurds Arajs and R. V. Colvin (U. S. Steel Corp. Research Center, Monroeville, Penna.). p.178-207 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The paramagnetic behavior of polycrystalline Ce, Pr, Nd, Sa, Eu, Gd, Th, Dy, Ho, Er, and Tm was studied above room temperature. All measurements, except those on europium, could be interpreted by using the tripositive ion model based on the localized 4f-electron approximation and the Van Vleck theory of paramagnetism. It was found that, besides the 4f-electron contribution to the total paramagnetism of any one of the rare earth metals, a small approximately temperature-independent paramagnetic susceptibility of magnitude 1×10^{-6} $g^{-1}cm^3$ exists, and originates from the conduction electrons. A tripositive europium ion model could be used only below the Neil temperature. (auth)

1687 STUDIES OF INTERMETALLIC COMPOUNDS BETWEEN THE LANTHANIDE METALS AND IRON, COBALT, NICKEL AND MANGANESE. W. E. Wallace and L. V. Cherry (Univ. of Pittsburgh). p.211-22 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Intermetallic compounds were prepared with stoichiometries represented by the formulas AB_2 and AB_5, in which A is a lanthanide of Y, and B is Fe, Co, Ni, or Mn. Magnetic studies showed that in 50 out of 69 compounds examined the moments are spontaneously coupled at room temperature. In a study of the ACo_5 series, YCo_5, $CeCo_5$, and $SmCo_5$ appeared to be Neil type-Q ferrimagnetic and $GdCo_5$, $HoCo_5$, and $ErCo_5$ appeared to be Neil type-P ferrimagnetic. The other four compounds, $PrCo_5$, $NdCo_5$, $DyCo_5$, and $ThCo_5$, did not appear to fall into any category. Heat capacity data for $DyCo_5$ revealed an accompanying specific heat anomaly, which was of unusual shape. (M.C.G.)

1688 OBSERVATIONS OF SOME GADOLINIUM–SELENIUM COMPOUNDS. R. C. Vickery and H. M. Muir (Research Chemicals, Burbank, Calif.). p.223-31 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Studies were made of the structural, electrical, magnetic, and chemical properties of the Gd–Se system between 50 and 70 at. % Se. The ionic covalent resonance in the Gd–Se bond is discussed. (M.C.G.)

1689 RARE EARTH INTERMETALLIC COMPOUNDS WITH ELEMENTS OF GROUPS V AND VI. J. F. Miller and R. C. Himes (Battelle Memorial Inst., Columbus, Ohio). p.232-40 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Results are presented of exploratory work with some rare earth compounds containing Sb, Bi, Se, and Te. The compounds were prepared by vapor-solid or vapor-liquid reactions. Melting points, crystal structures, electric properties, thermoelectric properties, and purity were determined. (M.C.G.)

1690 THEORY OF THE ELECTRON-TRANSPORT PROPERTIES OF THE 4f-ELECTRONS IN RARE EARTH COMPOUNDS. R. R. Heikes (Westinghouse Electric Corp., Pittsburgh). p.247-54 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The localized case of electron transport properties in rare earth compounds is outlined. Electrical conductivity and the Seebeck coefficient are discussed. The relation of the localized model to the standard broad-band treatment is described. (M.C.G.)

1691 SAMARIUM SULFIDES FOR SEMICONDUCTOR APPLICATION. M. D. Houston (Westinghouse Electric Corp., East Pittsburgh, Penna.). p.255-8 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The Sm–S system was found to consist of 4 distinct compounds and one solid-solution series. All compounds were refractory and crystallized in some cubic structure. The electrical characteristics were observed to shift from insulating to semiconducting as the sulfur concentration decreased. Compositions in the monosulfide region possessed favorable properties for thermoelectric applications. (M.C.G.)

1692 SCANDIUM—ITS PREPARATION AND PROPERTIES. A. H. Daane (Ames Lab., Ames, Iowa). p.261-8 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The extraction of scandium from thortveitite to provide Sc_2O_3 for metal preparation and the reduction of Sc_2O_3 are described. The properties of scandium including melting point, crystal structure, electrical resistivity, thermal expansion coefficient, corrosion resistance, and tensile strengths are discussed. Preparation of alloys is described. (M.C.G.)

1693 MECHANICAL PROPERTIES OF RARE EARTH METALS. B. Love and C. Kirkpatrick (Research Chemicals, Burbank, Calif.). p.269-77 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The behavior of yttrium, dysprosium, and erbium is, in general, comparable to other metals with a close-packed hexagonal crystal structure. The cast structures can be cold-worked, within limits, to improve mechanical properties. At a temperature of 1800°F all three were easily swaged to heavy reductions. The resulting structures were uniform and dense and the hardness and tensile strength increased with increasing reductions. Tensile properties were determined on both wrought and cast material. Ductility was improved by working. The cast rare earths were notch-sensitive. The fatigue properties followed the normal patterns of increased life with decreased maximum applied load. Recrystallization studies were made on cold deformed yttrium and erbium. Studies of the tensile properties of erbium–zirconium alloys showed greatly increased tensile strength over unalloyed erbium. (M.C.G.)

1694 EFFECTS OF ALLOYING ADDITIONS OF Sc, Y, RARE EARTHS, Th, AND Pu ON THE γ-α TRANSFORMATION OF CERIUM. K. A. Gschneidner, Jr., R. O. Elliott, and R. R. McDonald (Los Alamos Scientific Lab., N. Mex.). p.278-87 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The γ-α transformation of pure cerium was studied. The effects of alloying additions of plutonium, rare earths, scandium, thorium, and yttrium were determined. Experiments were performed at room temperature under high pressure and at low temperatures under atmospheric pressure. Plutonium and thorium were found to stabilize α-Ce, while the other alloying elements, at least under high pressure, did not. The results are discussed in terms of the valence, size, number of unpaired f-electrons, and the magnetic moment of the solute element. (auth)

1695 RARE EARTH METALS IN METALLURGY, CERAMICS, AND CERMETS. E. S. Funston and J. A. McGurty (General Electric Co., Cincinnati). p.288-96 of "Rare Earth Research." New York, The Macmillan Company, 1961.

Research work on rare earths and yttrium led to their useful applications in several fields. In metallurgy, small additions of rare earths and yttrium enhanced the oxidation resistance of ferrous and chromium base alloys, as well as having improved their workability. The scavenging effect of yttrium was utilized to produce a ductile vanadium metal. In ceramics the oxides of yttrium and rare earths are being used for high temperature stabilization of zirconium. In cermets they are used for nuclear-control applications. (auth)

1696 RARE EARTH BORIDES AND NITRIDES. Harry A. Eick (Michigan State Univ., East Lansing). p.297-305 of "Rare Earth Research." New York, The Macmillan Company, 1961.

An examination was made of rare earth boride phases with respect to their methods of preparation, structure, and high-temperature properties. The rare earth nitrides are discussed with respect to their stoichiometry. (auth)

1697 A STRUCTURAL SURVEY OF THE HEAVY RARE EARTH SILICIDES. Charles E. Lundin (Univ. of Denver). p.306-13 of "Rare Earth Research." New York, The Macmillan Company, 1961.

The existence of silicides of yttrium and the heavy rare earth metals with the stoichiometric ratio M_3Si_5 was established. M_3Si_5 compounds of yttrium and the heavy rare earths are structurally isomorphous. Two structural forms were determined for the M_3Si_5 compounds: hexagonal and orthorhombic. The anomalous formation behavior of these two closely associated structures and the factors which control their occurrence were also studied. (auth)

Analytical Procedures

Refer also to abstract 1301

1698 (AAEC/TM-52) AN ELECTROCHEMICAL OXYGEN METER. R. R. T. Morgan (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Oct. 1960. 11p.

A meter based on the galvanic cell was developed to enable traces of oxygen in gases to be determined. The instrument consists of four main parts: the galvanic cell, the electrolytic cell, the flowrate indicator, and the control unit. (M.C.G.)

1699 (CNI-88) AMPEROMETRIC DETERMINATION OF SMALL QUANTITIES OF Fe^{+++} BY ELECTROLYTICALLY GENERATED UO_2^+. G. B. Barbi (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Ispra). July 1961. 15p.

A coulometric method for evaluation of small quantities of ferric iron, even in the ferrous salt solutions used in radiation dosimetry was developed. It is based on the electrolytic generation of UO_2^+ which is determined amperometrically. Experiments were performed with quantities of Fe^{+++} between 0.02 and 2 mgr. with an accuracy better than 1%. (auth)

1700 (CNI-90) DETERMINAZIONE QUANTITATIVA DI SALI DI URANIO CON IL POLAROGRAFO OSCILLOGRAFICO. (Determination of the Amount of Uranium Salts with Oscillographic Polarography). S. Martini (Italy. Comitato Nazionale per l Energia Nucleare, Ispra). July 1961. 12p.

An oscillographic polarographic technique for the determination of uranium in 1.5$\underline{N}$ H_2SO_4 solutions was established. The sensitivity of the method is $1 \cdot 10^{-7}$ mol/l with a maximum error within 3 to 5%. The influence of Cu, Tl, Bi, and Mo was studied. (auth)

1701 (IA-631) SPECTROPHOTOMETRY OF LANTHANIDES IN FUSED SALT MEDIA. A Review on the Spectrophotometry of Fused Salts. J. Padova (Israel. Atomic Energy Commission, [Rehovoth]). July 1961. 16p.

The chemical behavior of fused salts was investigated by absorption spectrophotometry in the visible and ultraviolet range. Included are discussions of theory and results on pure salts, fused salt mixtures and solutions, and complex ions in molten salts. (J.R.D.)

1702 (PAN-237/X) QUANTITATIVE PAPER RADIOCHROMATOGRAPHY BY USE OF TOLLENS REAGENT. I. THE APPLICATION OF I^{131} FOR RADIOMETRIC ESTIMATION OF MONOSACCHARIDES AND POLYOLS. J. Z. Beer (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 17p.

A radiochromatographic quantitative method for determining saccharides is presented. The method is based on quantitative filter paper deposition of saccharide-reduced silver from ammoniacal silver nitrate (Tollen's Reagent). The deposit is transformed into AgI^{131} and counted. (J.R.D.)

1703 (PG-Report-194(2nd Ed.)) ANALYTICAL METHOD FOR THE DETERMINATION OF URANIUM-234 IN ENRICHED URANIUM HEXAFLUORIDE, TETRAFLUORIDE AND OXIDE BY AN ALPHA-COUNTING TECHNIQUE. (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England and United Kingdom Atomic Energy Authority. Engineering Group, Capenhurst, Ches., England). 1961. 7p.

Sample preparation and α counting are described followed by a description of the procedure for determining the total U which is required for calculation of U^{234}. The U^{234} is calculated from α-activity after corrections for the α-activity of other U isotopes. (J.R.D.)

1704 (PG-Report-246) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF SODIUM CHROMATE IN BRINE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 3p.

A method is outlined for the determination of sodium chromate in brine solutions as used in refrigerating systems. The sample is filtered and the chromate ion determined oxidimetrically in acid solution by titration with ferrous ammonium sulfate. The accuracy is ±25 ppm at 1500 ppm sodium chromate. (M.C.G.)

1705 (NP-tr-795) SEMI-MICRO CHROMATOGRAPHIC ANALYSIS OF GASES. XIII. SEPARATION OF CHLORINE, BROMINE AND IODINE. J. Janak, M. Nedorost, and V. Bubenikova. Translated by R. Todd (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Collection Czechoslov, Chem. Communs., 22: 1799-1804(1957). 17p.

Originally published in Chem. listy, 51: 890-4(1957).

The characteristic chromatographic spectra of chlorine, bromine, and iodine on silica gel have been determined at 15 to 140°C. It has been shown that volatile substances behave as gases during chromatography in the gas phase, and the linear relation, log U = k/T, is obeyed by all three halogens. A polarographic indicator system sensitive to the halogens after chromatography has been developed; the halogens are absorbed in a solution of Ti(III), and the increase in height of the Ti(IV)-wave is measured. The method has been used for the determination of bromine in the presence of large quantities of chlorine. (auth)

1706 DETERMINATION OF DIAMINE OXIDASE ACTIVITY BY LIQUID SCINTILLATION COUNTING. Tsuneo Okuyama and Yutaka Kobayashi (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Arch. Biochem. Biophys., 95: 242-50(Nov. 1961).

A rapid method for diamine oxidase assay is described. The method is based on the formation of radioactive toluene-extractable end product(s) from the action of diamine oxidase on cadaverine-C^{14}. The end products are extracted directly into toluene and assayed in a liquid scintillation spectrometer. The method is applicable using radioactive putrescine as substrate, but does not work with radioactive histamine. (auth)

1707 PHOTOGRAPHIC DETERMINATION OF TRITIUM IN WATER. K. Becker (Kernforschungsanlage, Jülich, Ger.). Atompraxis, 7: 358-60(Oct. 1961). (In German)

A new method for determining low tritium concentrations (ca. 0.05 μc/ml) in aqueous solutions is described. A highly sensitive photographic film is soaked for a considerable period in the liquid under examination. The blackening resulting from development of the film is then measured photometrically. Sensitivity can be increased by using a film containing terphenyl. The sensitivity measured in a conventional x-ray film indicates that tritium in the air may affect film badges worn by persons in a control area. (auth)

1708 MICRODETERMINATION OF THORIUM IN TAIWAN RIVER SANDS AND GRAVELS. Yih-Jian Wu. Bull. Inst. Chem. Acad. Sinica, No. 4: 23-8(June 1961). (In English)

A colorimetric method, in which thorin was applied after separation of thorium by Dowex 50 ion exchanger, was employed in the determination of minute amounts of thorium in Taiwan river sands and gravels. The results suggest that a small amount of thorium is present in common sands and gravels of Taiwan rivers. The thorium content in the sands downstream of Tamsui was higher than that of the middle stream. The analytical results are tabulated. (P.C.H.)

1709 THE EXTRACTION OF COLORED COMPLEXES FORMED BY REAGENTS OF THE ARSENAZO-THORON GROUP. V. I. Kuznetsov and S. B. Savvin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Doklady Akad. Nauk S.S.S.R., 140: 125-8(Sept. 1, 1961). (In Russian)

Organic reagents such as arsenazo-I, -II, and -III, and thoron are useful for the photometric determination of U, Pu, Th, rare earths and other elements. These reagents contain sulfo groups which make them readily soluble in water, and difficult to extract with organic solvents. The negative charge on the sulfo groups can be compensated by addition of salts of heavy, hydrophobic organic cations such as organic amine salts (diphenylguanidine), tetraphenylarsonium salts, or oxonium salts formed by tributylphosphate, β-napthol and cyclohexane. The proper anion must be used to compensate the plus charge of the cation. Chloride, sulfate or nitrate are sometimes used, but more hydrophobic anions such as rhodanide, perchlorate, chloracetate or trichloracetate may be required. Butyl or amyl alcohol are generally used as solvents because of their ability in replacing water of solvation. A number of practical examples are given. Thus, hexavalent uranium is extracted from weak HCl by addition of arsenazo followed by urotropine and diphenylguanidine chloride. Butyl or amyl alcohol is used to extract the rose complex. Thorium is extracted from 0.05 $\underline{N}$ HCl with thoron by successive additions of monochloracetic acid, diphenylguanidine chloride, and butyl or amyl alcohol as an extractant. Extraction can be performed from HCl or H_2SO_4 solutions with the use of arsenazo-III reagent. The arsenazo or thoron reagent can be used to precipitate Th or U from very dilute solutions (1 to 1 × 10^9) by addition of methyl violet or some other basic dye. The organic precipitate is dissolved in butyl alcohol, and the Th or U is determined photometrically. (TTT)

1710 THE DETERMINATION OF SOME ELEMENTS IN ALUMINIUM BY NONDESTRUCTIVE RADIOACTIVATION ANALYSIS. B. Chinaglia and R. Malvano (SORIN, Saluggia, Italy). Energia nucleare (Milan), 8: 571-8(Sept. 1961). (In English)

The use of γ ray spectroscopy methods in the radioactivation analysis of some elements in aluminium is described. Results obtained with pure aluminium (99.8%, 99.99%, zone refined) are reported, together with an evaluation of the precision and of the limits of the method. Some examples of fast analysis of aluminium alloys (cobalt, copper, gallium, and manganese) are also reported; in this case the precision was checked by independent spectrophotometric analysis. (auth)

1711 RHENIUM CONTENTS OF ROCKS. D. F. C. Morris and F. W. Fifield (Brunel Coll. of Tech., London). Geochim. et Cosmochim. Acta, 25: 232-3(Nov. 1961). (In English)

The results of some neutron activation analyses of rhenium in rocks are reported. The results quoted should be taken as maximum values, since a complete freedom from contamination cannot be guaranteed. Portions of Specpure silica were also analyzed and showed rhenium contents of 0.010 and 0.012 ppm. (P.C.H.)

1712 NEUTRON ACTIVATION ANALYSIS OF MOLYBDENUM, TIN, TANTALUM AND TUNGSTEN IN SILICATES. Hiroshi Hamaguchi (Tokyo Univ. of Education), Rokuro Kuroda, Tsuneo Shimizu, Ryuichiro Sugisita, Iwao Tsukahara, and Rycichi Yamamoto. J. At. Energy Soc. Japan, 3: 800-5(Oct. 1961). (In Japanese)

The simultaneous determination of microgram to submicrogram amounts of molybdenum, tin, tantalum, and tungsten in silicate rocks was arrived at using the Japanese reactor JRR-1. A sample and comparative standard were irradiated simultaneously with a neutron flux of about 3×10^{11} ncm^{-2} sec^{-1} for 3 days (intermittently, 5 hr each day). After cooling for a day, the sample was decomposed with sulfuric and hydrofluoric acids in the presence of carriers and lanthanum hold-back carrier. Following the removal of lanthanide activities as fluorides, the fluoride complex of tantalum was extracted by isopropylacetone. Tin and molybdenum were precipitated with hydrogen sulfide from the remaining activities in the aqueous phase, to which boric and tartaric acids were added to mask hydrofluoric acid and tungstate ions, respectively. The α-benzoinoxime precipitation method was then applied for the recovery of bulk of tungsten in the filtrate from the sulfides. Further decontamination chemistry was carried out for each element. The amount of the elements was estimated by comparing Mo^{99} (67 hr), Sn^{121} (27.5 hr), Ta^{182} (111 d), and W^{187} (23.9 hr) β activities isolated from the sample with those from the comparative standard. Sensitivities of the method were ~1 ppm for Mo and Sn, ~0.1 ppm for Ta, and ~0.01 ppm for W. (auth)

1713 RADIOMETRIC ESTIMATION OF TRACES OF ZIRCONIUM. K. R. Kar and B. C. Sawhney (Univ. of Delhi). J. Sci. Ind. Research (India), 19B: 401-3(Oct. 1960). (In English)

A radiometric method for estimating traces of zirconium (~2 μg), alone or in the presence of Ce^{4+} and lanthanum, was developed. The method involves radiometric estimation of the quantity of phosphorus removed from a standard pyrophosphate solution (tagged with P^{32}) by the unknown sample of zirconium as the insoluble ZrP_2O_7. Knowing the specific activity of the precipitant pyrophosphate solution before and after precipitation of ZrP_2O_7, the amount of phosphorus thus separated, and hence the zirconium present in the unknown sample, is determined. Silver iodide, produced in situ in 0.4$\underline{N}$ nitric acid and containing an excess of iodide, is used as the carrier. For the estimation of zirconium in the presence of Ce^{4+} and lanthanum, silver thiocyanate is used as the carrier. In order to avoid interference by Ce^{4+}, the latter is reduced with a little hydrogen peroxide before precipitation of ZrP_2O_7. A single estimation can be carried out within 90 min with an accuracy of ±1.0%. (auth)

1714 POTENTIOMETRIC DETERMINATION OF THALLIUM (III) BY MEANS OF VANADIUM (II). S. I. Gusev and L. A. Ketova (Perm State Medical Inst., [USSR]). Zhur. Anal. Khim., 16: 552-4(Sept.-Oct. 1961). (In Russian)

A possibility was established for the potentiometric determination of thallium(III) by titration with a solution of a vanadium(II) salt in 6–10 $\underline{N}$ hydrochloric (sulfuric) acid by the development of a method for the successive determination of thallium and bismuth when present together. Large amounts of Zn, Cd, or Pb, do not interfere. The method can be used for industrial materials. (auth)

1715 POLAROGRAPHIC BEHAVIOUR OF INDIUM IN THE PRESENCE OF TRIHYDROXYGLUTARIC ACID.

E. N. Vinogradova and Ching-ju An (Moscow State Univ.). Zhur. Anal. Khim., 16: 555-61(Sept.-Oct. 1961). (In Russian)

The polarographic behavior of indium in the presence of trihydroxyglutaric acid in acid, neutral, and alkaline media was studied. The value of the half-wave potential of a simple indium ion was determined in $HClO_4$ by the half-peak potential during the anodic dissolution of indium from an amalgam. The half-wave potential is equal to 0.488 v. The effect of the concentration of trihydroxyglutaric acid on the $E_{1/2}$ of indium was studied. It was found that the regular shift of $E_{1/2}$ on changing the concentration of trihydroxyglutaric acid is observed only at pH 4 and pH 11. The coordination number p = 2 and the unstability constant for the indium-trihydroxyglutaric acid complex at pH 4 were found. K (mean) is $(9.73 \pm 0.82) \times 10^{-11}$. It was established that the process of indium reduction at pH 11 is irreversible. A method was suggested for the polarographic determination of indium and cadmium, when present together, in trihydroxyglutaric acid at pH 3 and pH 9. (auth)

1716 ANALYTICAL APPLICATION OF 8-MERCAPTOQUINOLINE (TRIOOXINE) AND ITS DERIVATIVES. COMMUNICATION 18. GALLIUM, INDIUM AND THALLIUM THIOOXINATES. PHOTOMETRIC DETERMINATION OF INDIUM WITH THIOOXINE. Yu. A. Bankovskii, Ya. A. Tsirule, and A. F. Ievin's (Inst. of Chemistry, Academy of Sciences, Riga). Zhur. Anal. Khim., 16: 562-72(Sept.-Oct. 1961). (In Russian)

Crystalline $Ga(Ca_9H_6NS)_3$, $In(C_9H_6NS)_3$, and C_9H_6NSTI thiooxinates were synthesized. It was established spectrophotometrically that gallium thiooxinate dissociates in organic solvents with the formation of $Ga(C_9H_6NS)_{2+}$ ion. Indium thiooxinate is inclined to the same dissociation, but to a lesser degree. The values of molar extinction coefficients are measured for gallium (ε – 8400) and indium (ε – 1100) thiooxinates in absorbance maxima. The molar extinction coefficient of thallium thiooxinate is about 4000, and this confirms its suggested composition C_9H_6NSTI. Indium and thallium thiooxinates have the same composition both in organic solvent solutions and in the crystal state. Gallium thiooxinate is formed at a ratio Ga: R = 1 : 2, so, apparently, a complex $Ga(C_9H_6NS)_2Cl$ or a base thiooxinate $Ga(C_9H_6NS)_2OH$ is extracted by organic solvents. In the tenfold excess of thiooxine, in comparison with the amount necessary for the formation of thiooxinates, gallium is extracted at pH 6.5–10, indium at pH 4–13, and thallium at pH 9–14. Under like conditions gallium 8-hydroxyquinolinate is extracted at pH 3.5–11 and indium 8-hydroxyquinolinate at pH 5–13. A method was developed for the determination of indium with thiooxine (8-mercaptoquinoline). Indium thiooxinate $In(C_9H_6NS)_3$ is extracted by toluene at pH 4–12.5. From 0.5 to 60 γ In in 50 ml can be determined. In an alkaline medium considerably prevailing amounts of Cu, Ag, Au, Fe, Co, Ni, Pd, Pt can be masked with potassium cyanide. Ge, V, As, Mo, W, Re, U, and all the elements which do not form stable sulfides in aqueous solutions do not interfere. Mn, Zu, Hg, Ga, Tl, Sn, Pb, Sb, and Bi interfere. The advantage of the method is the possibility of the determination of γ-amounts of indium in the presence of highly prevailing amounts of Ag, Au, Pd, Pt without the preliminary separation. The thiooxine method of the determination of indium in an alkaline medium in the presence of potassium cyanide is more selective than the 8-hydroxyquinoline method. (auth)

1717 EXTRACTION-PHOTOMETRIC DETERMINATION OF MOLYBDENUM BY MEANS OF 6,7-DIHYDROXY-2,4-DIPHENYLBENZOPYRYLIUM CHLORIDE. A. I. Busev and Fan Chang (Moscow State Univ.). Zhur. Anal. Khim., 16: 578-84(Sept.-Oct. 1961). (In Russian)

Of the four dihydroxychrommenols studied (6,7-dihydroxy-2,4-dimethylbenzopyrylium chloride; 7,8-dihydroxy-2,4-dimethylbenzopyrylium chloride; 6,7-dihydroxy-2,4-diphenyl, benzopyrylium chloride; and 7.8-dihyroxy-2,4-diphenylbenzopyrylium chloride) as reagents for molybdenum (VI), the best results were obtained with 6,7-dihydroxy-2,4-diphenyl-benzopyrylium chloride. The composition of the compound of molybdenum with 6,7-dihydroxy-2,4-diphenylbenzopyrylium chloride was established. The molar absorptivity is $(5.04 \pm 0.03) \times 10^4$. An extraction-photometric method for determining molybdenum in steels was worked out. The sensitivity of the method is 0.01 γ/ml of Mo. The method permits microgram quantities of molybdenum to be determined in the presence of Ni, Co, Ca, Zn, Cu, Mn, and Cr. Bismuth and large quantities of iron do not interefere in the presence of complexone III. Tungsten interferes. (auth)

1718 INVESTIGATIONS IN THE ANALYTICAL CHEMISTRY OF URANIUM. COMMUNICATION 4. PHOTOMETRIC DETERMINATION OF URANIUM WITH ARSENAZO WITH ARSENAZO I AFTER ITS SEPARATION FROM ADMIXTURES USING EDE- 10p ANIONITE. L. M. Moiseeva, N. M. Kuznetsova, V. F. Lukyanov, and G. L. Selmanova. Zhur. Anal. Khim., 16: 585-7(Sept.-Oct. 1961). (In Russian)

A method has been developed for the photometric determination of uranium in ores by means of arsenazo I after its separation from admixtures using ETSE-10p anionite. (auth)

1719 SPECTROPHOTOMETRIC DETERMINATION OF ULTRA-SMALL QUANTITIES OF NICKEL IN INDIUM. V. M. Peshkova, V. M. Bochkova, and E. K. Astakhova (Moscow State Univ.). Zhur. Anal. Khim., 16: 596-8(Sept.-Oct. 1961). (In Russian)

α-Benzil dioxime permits the determination of nickel by measuring optical density in the region of maximum absorption (at 275 mμ), after the reagent excess is removed by washing the extract with alkali. Conditions were found for the spectrophotometric determination of ultra-small quantities (down to 0.005 γ) of nickel with α-benzil dioxime in the solution of its pure salt, in the presence of cobalt and copper. A method was developed for the determination of traces of nickel down to $5 \times 10^{-7}\%$ in metallic indium. The reproducibility of the method is +25%. (auth)

1720 DETERMINATION OF SULPHUR, CHLORINE AND FLUORINE IN BERYLLIUM OXIDE BY A SPECTROGRAPHIC METHOD. I. A. Berezin and K. V. Aleksandrovich. Zhur. Anal. Khim., 16: 613-16(Sept.-Oct. 1961). (In Russian)

A method was developed for the spectrographic determination of sulfur, chlorine, and fluorine in beryllium oxide by means of a hollow cathode. The method permits the determination of 0.001% of chlorine: 0.003% of sulfur, and 0.005% of fluorine in 50 mg samples. The mean relative error is ±15–20%. (auth)

1721 SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN NIOBIUM. A. A. Baskin, E. I. Zakharov, K. I. Petrov, and E. I. Rzhekhina. Zhur. Anal. Khim., 16: 627-30(Sept.-Oct. 1961). (In Russian)

A method for the spectrographic determination of iron, silicon, tantalum, and lead in niobium, and a method for preparing highly pure niobium pentoxide, which is used for spectral standards, were developed. (auth)

1722 DETERMINATION OF TITANIUM IN TITANIUM CARBIDE–NIOBIUM ALLOYS. E. E. Kotlyar and T. N.

Nazarchuk (Inst. of Metalloceramics and Special Alloys, Kiev). Zhur. Anal. Khim., 16: 631-4(Sept.-Oct. 1961). (In Russian)

A method was developed for the titrimetric determination of titanium in titanium—niobium alloys after its reduction with metallic aluminium in the presence of fluorides, oxalic, tartaric, citric acids, or complexone III in a sulfuric acid medium. Hydrochloric acid promotes the reduction of niobium. The method was used for the determination of titanium in titanium carbide—metallic niobium systems. (auth)

1723 CHROMATOGRAPHIC SEPARATION OF WEIGHABLE AMOUNTS OF CESIUM AND RUBIDIUM OF A KY-1 CATION EXCHANGE RESIN. A. A. Pozdnyakov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim., 16: 647-8(Sept.-Oct. 1961). (In Russian)

A study was made of the possibility of separating weighable amounts of Rb and Cs, when present in various ratios on a KY-1 cation exchange resin, by means of HCl of various concentrations. It was shown that when the elution is carried out with 0.75 $\underline{M}$ HCl, the effective separation of elements may be achieved at the following ratios of their amounts: 1 : 1, 1 : 80, and 70 : 1. When 5.5 $\underline{M}$ HCl is used for elution, the separation of weighable amounts, in contrast to microconcentrations, is not observed. Some theoretical considerations explaining these phenomena are given. (auth)

1724 ANALYSIS OF REFRACTORY ALLOYS CONTAINING ZIRCONIUM (TITANIUM) AND TUNGSTEN. O. I. Popova and V. I. Kornilova (Inst. of Metalloceramics and Special Alloys, Kiev). Zhur. Anal. Khim., 16: 651-2(Sept.-Oct. 1961). (In Russian)

A method was developed for the determination of titanium (zirconium) and tungsten in TiB_2—WC; and ZrB_2—WC. The method is based on the separation of the elements by precipitating titanium (or zirconium) cupferronate in the presence of oxalic acid to mask tungsten and by extracting the cupferronate, followed by the determination of tungsten with 8-quinolinol and of titanium and zirconium by a gravimetric cupferron method. (auth)

1725 IMPROVEMENTS IN AND RELATING TO THE DETECTION AND/OR ANALYSIS OF LOW CONCENTRATIONS OF GASES AND VAPOURS. James Ephraim Lovelock (to National Research Development Corp.). British Patent 882,977. Nov. 22, 1961.

An ionization detector is designed for detecting low concentrations of gases and vapors, especially organic vapors, in the gas stream issuing from the gas chromatographic column. The detector uses as an eluant a rare gas having an excitation potential higher than the ionization potential of the substances being detected. The rare gas is excited to a metastable state by means of ionizing radiation, e.g., alpha or beta particles, and the ions formed by the transfer of the excitation energy from the rare gas to the substances are detected relative to the ions in a second rare gas stream from which the substances are absent. (D.L.C.)

General Inorganic and Physical Chemistry

Refer also to abstract 2762

1726 (AAEC/E-63) SEPARATING SMALL PARTICLES FROM LIQUIDS WITH THE HYDROCYCLONE. PART II. EFFECTS OF MAJOR DESIGN VARIABLES. R. C. Cairns, E. G. Thurstan, and K. S. Turner (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Sept. 1959. Re-issued June 1961. 15p.

Hydrocyclone feed, overflow, and underflow diameters are established for optimum concentration of solid and maximum clarification of liquid using an 11.5 ± 0.5% by weight suspension of sub-sieve barium sulfate in water. For a hydroclone with a nominal diameter (D_c) of 10 millimeters the dimensions for optimum concentration are: feed diameter (D_i) = 0.082 in. ($D_c/5$), overflow diameter (D_0) = 0.098 in. ($D_c/4$), underflow diameter (D_u) = 0.037 in. ($D_c/11$), and vortex finder outside diameter (VFOD) = 0.197 in; and the dimensions for maximum clarification are: D_i = 0.055 in. ($D_c/7$), D_o = 0.079 in. ($D_c/5$), D_u = 0.058 in. ($D_c/7$), and VFOD = 0.197 in. Brief observations are given on the air core and the effects of feed solid concentration and feed solid particle size. (auth)

1727 (AAEC/E-65) SEPARATING SMALL PARTICLES FROM LIQUIDS WITH THE HYDROCYCLONE. PART III. EFFECTS OF MAJOR OPERATING VARIABLES. E. G. Thurstan and K. S. Turner (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1961. 31p.

For cyclone configurations producing flow ratios of 0.1 or less, the concentration efficiency increases as the feed concentration increases and then levels out at a concentration defined as the critical feed concentration. The clarification efficiency is independent of feed concentration up to concentrations slightly less than the critical feed concentration and then decreases. Both efficiencies increase logarithmically with flow rate. For a cyclone configuration of feed diameter (D_i) = 0.082 in., overflow diameter (D_o) = 0.098 in., and underflow diameter (D_u) = 0.037 in., correlations are proposed for the critical feed concentration in terms of the effective density ratio and concentration and clarification efficiencies in terms of the feed concentration, feed flow rate, and the Rosin-Rammler-Bennett size distribution constant of the solid. For cyclone configurations producing flow ratios from 0.2 to 0.5, the concentration efficiency is of minor importance. The clarification efficiency is found to be practically independent of concentration and also of flow rate except for materials with large distribution constants. Correlations are proposed for the clarification efficiency for a cyclone configuration of D_i = 0.055 in., D_o = 0.079 in., D_u = 0.058 in. Optimum results may be obtained for a given suspension by choosing suitable flow ratios and hence cyclone configurations for each stage of a multi-stage unit. However, for maximum flexibility in handling changes in operating variables, a unit combining constant cyclone configuration with underflow throttling would be preferable. The concentration and clarification efficiencies are not greatly affected by the average particle size or size distribution of the solid but the degree of classification obtained is markedly affected by both. (auth)

1728 (AAEC/E-67) PURIFICATION OF CARBON DIOXIDE FOR REACTOR PURPOSES. PART II. PRESSURE LOSSES THROUGH PACKED BEDS OF SELECTED DESICCANTS. A. Draycott and A. C. Kerr (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1961. 29p.

Pressure losses were measured for the flow of carbon dioxide, air, argon, helium, hydrogen, and methane through beds of molecular sieves, and for carbon dioxide and air through beds of activated alumina. It is shown that at the levels of moisture impurity expected in the Australian

HTGCR no increased pressure loss caused by adsorption should be encountered. The effect of temperature was studied but in all cases was found to be slight. The coefficients a' and b in Ergun's modified equation, $\Delta P/LV_0 = a'\mu + bG$, were calculated for all cases. Generally, good correlations were obtained although the low molecular weight gases, particularly hydrogen, showed considerable deviation. (auth)

1729 (AAEC/E-72) QUANTITATIVE STUDIES IN COMPLEX CHEMISTRY. PART I. ELECTROMETRIC METHODS. H. J. de Bruin and T. M. Florence (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1961. 32p.

Methods for the determination of stability constants are considered with particular reference to the method of pH titration. Mathematical derivations proposed by several authors are discussed and rationalized by using a common symbolism. The use of acid association constants is advocated in preference to dissociation constants. The beryllium/oxalate system is used to illustrate the methods Suggestions are made for the application of the fundamental data to problems in chemical processing and analytical chemistry. (auth)

1730 (AAEC/E-76) THE FORMATION CONSTANTS OF THE BERYLLIUM THENOYLTRIFLUOROACETONATES. H. J. de Bruin and R. B. Temple (Australia. Atomic Energy Comission Research Establishment, Lucas Heights, New South Wales). Sept. 1961. 11p.

The formation constants of the mono- and bis-thenoyltrifluoroacetone complexes of beryllium are measured by a solvent extraction method. The values found are $\beta_1 = 3.40 \times 10^5$ and $\beta_2 = 1.21 \times 10^{11}$, in a medium of ionic strength 0.1, at a temperature of 25° ± 0.1°. (auth)

1731 (AERE-R-3801) THE THERMAL DECOMPOSITION OF MAGNESIUM HYDROXIDE. PART II. DECOMPOSITION OF LARGE SINGLE CRYSTALS. P. J. Anderson and R. F. Horlock (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 18p.

The decomposition kinetics of $Mg(OH)_2$ are studied, and observations are made on brucite ($Mg(OH)_2$) crystals of mm dimensions. The role of bulk defects in the reaction is evaluated by optical microscopy of crystals during decomposition. The decomposition process involves three stages, not all of which may be distinguished experimentally for a given starting material. The primary stage consists of a perturbation of the hydroxide lattice. This is followed by removal of water from the crystal, and finally recrystallization to the cubic MgO lattice takes place. The occurrence of any of these three stages simultaneously is largely determined by the nature of the initial $Mg(OH)_2$. (auth)

1732 (AERE-R-3814) THE DIFFUSION OF OXYGEN IN NITROGEN IN THE PORES OF GRAPHITE. SYSTEMATIC INVESTIGATION OF A CROSS SECTION OF A BLOCK OF PILE A GRAPHITE. G. F. Hewitt and J. R. Morgan (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 53p.

The permeability and diffusivity characteristics of grade A pile graphite are studied. Variations of these parameters within the section and the effect on diffusivity of differential pressure and time (i. e., transient diffusion) are investigated. The diffusivity is found to be about a hundredth of the value for free gases. (auth)

1733 (BM-RI-5878) DETERMINATION OF OXIDE SOLUBILITY IN MOLTEN FLUORIDES. Bernard Porter and E. A. Brown (Bureau of Mines. Reno Metallurgical Research Center, Nev.). Dec. 1960. 11p.

The solubility of UO_2 is determined at 1250°C in ternary melts containing UF_4, BaF_2, and either CaF_2, LiF, or SrF_2. The solubility of CeO_2 is measured at 800 and 850°C in a solution of CeF_3, BaF_2, and LiF. The amount of La_2O_3 that dissolves at 950°C in a binary mixture of LiF and LaF_3 and a ternary mixture of LiF, LaF_3, and BaF_2 is also measured. In each case, the amount of soluble oxide is found to be less than 5 wt %. A procedure is also developed for filtering fused, oxide-saturated fluoride melts in order to obtain a representative sample for chemical analysis. The oxide content of the samples is determined by an inert-gas fusion procedure. (auth)

1734 (TID-14087) POLYMERIZATION IN THE CRYSTALLINE STATE. III. METHACRYLIC ACID AND BUTADIENE-1-CARBOXYLIC ACID. H. Morawetz and I. D. Rubin (Brooklyn. Polytechnic Inst. Polymer Research Inst.). [1961]. Contract AT(30-1)-1715. 12p.

Methacrylic acid polymerized in the solid state leads to a much less syndiotactic polymer than when polymerized in the liquid state. This is taken as additional evidence for the importance of the geometry of the monomer crystal lattice in solid state polymerization. Butadiene-1-carboxylic acid polymerizes spontaneously in the solid state to a cross-linked product, while the sodium, potassium, and barium salts of the acid are stable and polymerize very little even on gamma irradiation. (auth)

1735 (TID-14203) THE ENERGY LEVELS OF HEXAGONAL $ErCl_3$. F. Varsanyi and G. H. Dieke (Johns Hopkins Univ., Baltimore). [1961]. Contract AT(30-1)-1447. 30p.

The absorption spectrum of Er^{3+} in $LaCl_3$ was extended in the ultraviolet to 2430Å. New fluorescence data were obtained by monochromatic excitation which yielded all the Stark components of several low-lying levels including the ground state. The crystal field splittings were calculated for all levels. Comparison with the 28 empirical electronic states gives good agreement. The reason for observed discrepancies is believed to lie in inadequacies in the free ion wave functions. (auth)

1736 (WADD-TR-60-911) RESEARCH ON INORGANIC POLYMER SYSTEMS. Allen L. McCloskey, William G. Woods, Robert J. Brotherton, George W. Willcockson, Harry Goldsmith, Marlowe L. Iverson, Kiyoshi Kitasaki, Harold M. Manasevit, Herbert C. Newsom, and Lowell L. Petterson (United States Borax Research Corp., Anaheim, Calif.). Dec. 1960. Contract AF33(616)-7303. 278p.

Investigations are included on the chemistry of thermally stable inorganic and semi-inorganic polymer systems showing promise of stability at high temperatures. Systems based on B−B, B−N, Al−Q, and Al−N bonding have been studied as well as polymers containing tin, various pi-bonded systems, and alternate approaches to inorganic polymer systems. (auth)

1737 (AEC-tr-4876) ION EXCHANGE IN MIXED SOLVENTS. III. DISTRIBUTION OF THORIUM CHLORIDE BETWEEN HYDROCHLORIC-ACID SOLUTIONS CONTAINING ALCOHOL, AND STRONGLY BASIC ANION EXCHANGERS. J. Korkisch and F. Tera. Translated by Lydia Venters (Argonne National Lab., Ill.) from J. Inorg. & Nuclear Chem., 15: 177-81(1960). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 1469.

1738 (CEA-tr-R-1411) PROPRIETES THERMIQUES DE L'EAU SOUS DES PRESSIONS ATTEIGNANT 1200 kg/cm^2 ET A DES TEMPERATURES ATTEIGNANT 300°C. (Thermal Properties of Water under Pressures up to 1200 kg/cm^2 and Temperatures up to 300°C). M. P. Vukalovich, B. V. Dzampov, D. S. Rasskazov, and S. A. Remizov. Translated into French by B. de Trezvinsky from Teploenergetika, 7: No. 7, 4-12(1960). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 2009.

1739 (NP-tr-811) GASEOUS RUTHENIUM OXIDES AT HIGH TEMPERATURES. H. Schaefer, W. Gerhardt, and A. Tebben. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Angew. Chem., 73: 27(1961). 3p. (Handwritten MS. copy).

Entrainment studies are discussed for the formation of gaseous ruthenium oxides from the oxidation of RuO_2 in oxygen at 800°C, ruthenium wire in oxygen–nitrogen mixtures at 1465 to 2090°C, and ruthenium wire coated with RuO_2 in oxygen at 1200°C. (B.O.G.)

1740 (UCRL-Trans-535(L)) USE OF ION EXCHANGE IN STUDYING THE STATE OF A SUBSTANCE IN SOLUTION. IV. STUDY OF COMPLEX-FORMATION OF YTTRIUM WITH LACTIC ACID BY THE METHOD OF "ABSORPTION CURVES." V. I. Paramonova, A. N. Mosevich, and A. I. Subbotina. Translated for Univ. of California Lawrence Radiation Lab., Livermore from Zhur. Neorg. Khim., 3: 88-94(1958). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 13808.

1741 CELL PARAMETERS AND SPACE GROUPS OF POTASSIUM, RUBIDIUM, AND CESIUM ACID CHLOROMALEATES. R. D. Ellison, H. A. Levy, and S. W. Peterson (Oak Ridge National Lab., Tenn.). Acta Cryst., 14: 1204-5 (Nov. 10, 1961).

The cell parameters and space groups of the potassium, rubidium, and cesium acid chloromaleates grown from aqueous solution are determined. The results are tabularly presented. (N.W.R.)

1742 ELECTROCHEMICAL BEHAVIOR OF O_2 AND H_2O_2 ON ELECTRODE OF Zr, Ta, AND Al. G. Bianchi, G. Caprioglio, F. Mazza, and T. Mussini (Università, Milan). Chim. e ind. (Milan), 43: 867-71(Aug. 1961). (In Italian)

Values of overvoltage and polarization curves are reported. Results obtained by using Al, Ta, and Zr as electrodes are compared with others, obtained with titanium. Overvoltage for the cathode reduction of oxygen decreases in the following orders: Zr, Ta, Ti in acid solutions; Al, Ta, Zr, Ti in neutral solutions; Zn, Ti, Ta in alkaline solutions. (auth)

1743 TWO NEW COMPOUNDS OF THE ZIRCONIUM–OXYGEN–POTASSIUM SYSTEM. Paul Hagenmuller and Michel Tournoux (Faculté des Sciences, Rennes, France). Compt. rend., 253: 465-7(July 17, 1961). (In French)

Above 950°C potassium nitrate in excess reacts with zirconium dioxide to form the metazirconate K_2ZrO_3. By the action of a current of carbon dioxide, this compound is decomposed giving a $K_2Zr_8O_{17}$ phase, stable between 300 and 430°C. (tr-auth)

1744 SOME ALKALINE SALTS OF DICHLORO AND DIBROMO URANIC ACIDS. Jacques Prigent and Jacques Lucas (Faculté des Sciences, Rennes, France). Compt. rend., 253: 474-9(July 17, 1961). (In French)

Some new compounds of uranium, the dichloro and dibromo uranates of potassium, were prepared by the action of oxygen on uranyl halides of potassium. They originate by combination between the potassium hydroxide and the chloride and bromide of monohydrate uranyls and should be considered as dichloro and dibromouranic acids. The corresponding ammonium salts are prepared by the action of ammonia on these acids. (tr-auth)

1745 OXIDATION OF NIOBIUM. Tor Hurlen (Instituto Central de Investigacion Industrial, [Oslo]). Inst. hierro y acero, 13: 714-28(July-Sept. 1960). (In Spanish)

By means of semicontinuous gravimetric and volumetric measurements, determinations were made of the reaction rate for oxidation of niobium as a function of time at 150 to 1000°C, and for the majority of temperatures, at oxygen pressures of 760 to 10^{-2} mm Hg. Following these measurements, investigations were carried out in oxidized samples using x-ray diffraction, electron diffraction, electron microscopy, and metallographic techniques. Various x-ray diffraction measurements were realized directly on samples yielded in the oxidation. It was observed that niobium reacts with oxygen in sufficiently complex and little known ways, although, to appearances, a narrow correlation exists between the oxidation rate curves and the oxidation products formed. A study is shown of this which clarifies the effects of temperature, oxygen pressure, and time on the oxidation behavior of niobium. It is necessary to mention that the oxidation is considerable at 200 to 250°C; that the dissolution of oxygen inside the metallic niobium system played an essential part during the initial stage of oxidation; that two different suboxides, NbO_x and NbO_y, were discovered in the oxidation products, in addition to the well-known oxides, NbO, NbO_2, and Nb_2O_5; and that, on the upper surface of the oxide, an oxidized coating appears at 800 to 1000°C. (tr-auth)

1746 THE ADHESION OF SOLID PARTICLES TO SOLID SURFACES. I. A REVIEW. Morton Corn (Harvard School of Public Health, Boston). J. Air Pollution Control Assoc., 11: 523-8(Nov. 1961).

Studies clarifying the mechanism of small-particle adhesion were conducted to aid research in aerosol sampling, dust filtration, dust re-entrainment, and soiling phenomena. It was found that the London-van der Waals molecular forces cannot be successfully extended to quantitatively predict adhesion forces of small particles in air in which absorbed gases prevent close approach of surfaces. Ambient air relative humidity influences adhesion, and the real area of contact between particles and surfaces or other particles differs from the apparent area. Static electrification effects may also alter adhesion. Other possible effects are mentioned, although few studies were conducted along those lines. (L.N.N.)

1747 SOLVENT EFFECT ON A PRIMARY CARBON ISOTOPE EFFECT—DECARBOXYLATION OF TRINITROBENZOATE ION IN WATER AND ETHANOL–WATER MIXTURE. Peter Riesz and Jacob Bigeleisen (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 81: 6187-9(Dec. 5, 1959).

Carboxyl carbon C^{12}-C^{13} isotope effects are determined for the decarboxylation of trinitrobenzoate ion in water and 90% ethanol between 30 and 80°. A small but significant difference is found in the isotope effects in the two solvents. The difference is correlated with solvation effects. (auth)

1748 THE UNCHARGED MIXED HALIDES OF MERCURY(II). EQUILIBRIUM CONSTANTS AND ULTRAVIOLET SPECTRA. Thomas G. Spiro and David N. Hume (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc., 83: 4305-10(Nov. 5, 1961).

A general method is given for the study of the mixed complex formation equilibrium, $MA_2 + MB_2 = 2\ MAB$, and is applied to spectrophotometry. A spectrophotometric study of the uncharged mixed mercuric halides at 25° in a 10^{-3}M perchloric acid medium gave the following equilibrium constants (log units) for the above reaction: 1.07 ± 0.08, 1.35 ± 0.17, and 1.14 ± 0.11 for HgBrI, HgClI, and HgClBr, respectively. These results are compared with those of a previous solvent extraction study of the same systems, and the stability in excess of that predicted statistically (log K = 0.60) for all three mixed complexes is rationalized on the basis of polar interactions. The ultraviolet spectra of the complexes are also discussed. (auth)

1749 THE PREPARATION AND SOME PROPERTIES OF PLATINUM HEXAFLUORIDE. Bernard Weinstock, John G. Malm, and E. Eugene Weaver (Argonne National Lab., Ill.). J. Am. Chem. Soc., 83: 4310-17 (Nov. 5, 1961).

Platinum hexafluoride is the first simple hexavalent platinum compound that has been prepared. This was achieved by burning a platinum wire in a fluorine atmosphere adjacent to a cold surface with yields of up to 70%. The formula was established by chemical analyses and vapor density. A solid transition occurs at 3.0°, 32.5 mm pressure and the fusion point is 61.3°, 586 mm. The heat of transition is 2140 cal $mole^{-1}$ and the heat of fusion is 1080 cal $mole^{-1}$. The vapor pressure equations are: orthorhombic solid, $\log P\ (mm) = -3147.6/T - 6.09 \log T + 27.7758$; cubic solid, $\log P\ (mm) = 2528.7/T - 4.080 \log T + 20.6280$; liquid, $\log P\ (mm) = -5685.8/T - 27.485 \log T + 89.14962$. The boiling point is 69.14°, which is the highest boiling point of the known hexafluorides. The heat of vaporization at the boiling point is 7060 cal $mole^{-1}$. The liquid density is 3.826 g cc^{-1} at 64.3°. The density of the low temperature solid varies between 6.0–5.0 g cc^{-1} in the range 77–254°K. The vapor and liquid are red in color and the solids appear black. The molecule does not rotate freely in any of the condensed phases. Platinum hexafluoride is the least stable and most reactive of the known hexafluorides. The use of PtF_6 as a fluorinating agent at room temperature to form BrF_5, NpF_6, and PuF_6 is described. (auth)

1750 THE CHEMISTRY OF RUTHENIUM(IV). I. RUTHENYL AND THE NATURE OF Ru(IV) IN PERCHLORIC ACID SOLUTIONS. Frank P. Gortsema and J. W. Cobble (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 83: 4317-21 (Nov. 5, 1961).

Information was obtained on the nature of Ru(IV) in perchloric acid through solubility studies. The average charge on the aqueous species is +2. Extensive polymerization was observed in these solutions, and the monomer ruthenyl, RuO^{2+}, was identified and isolated as a constituent. (auth)

1751 A COÖRDINATION MODEL AS AN ALTERNATIVE TO THE SOLVENT SYSTEM CONCEPT IN SOME OXYCHLORIDE SOLVENTS. I. SIMILARITY IN THE BEHAVIOR OF PHOSPHORUS OXYCHLORIDE AND TRIETHYL PHOSPHATE AS NON-AQUEOUS SOLVENTS. Devon W. Meek and Russell S. Drago (Univ. of Illinois, Urbana). J. Am. Chem. Soc., 83: 4322-5 (Nov. 5, 1961).

The solution behavior of anhydrous ferric chloride in triethyl phosphate [$PO(OEt)_3$] is shown to be very similar to the reported behavior of ferric chloride in phosphorus oxychloride. Spectral investigations demonstrate that the tetrachloroferrate(III) ion, $[FeCl_4]^-$ on dissolution of ferric chloride in triethyl phosphate is a direct proof that ionization of some $FeCl_3$ produces a cationic iron(III) species. This is interpreted as strong support for using a similar Lewis acid-base mechanism to explain the data in both $POCl_3$ and $PO(OEt)_3$. It is not necessary to obtain a chloride ion from the solvent $POCl_3$ to form $[FeCl_4]^-$. The equilibria shown are proposed to explain the behavior of ferric chloride in triethyl phosphate and to serve as an alternative to the solvent system explanation for phosphorus oxychloride solutions. $FeCl_3 + Y_3PO \rightarrow [FeCl_3OPY_3] \rightleftharpoons [FeCl_{3-x}(OPY_3)_{1+x}]^{x+} + X[FeCl_4]^- \rightleftharpoons [Fe(OPY_3)_n]^{3+} + 3[FeCl_4]^-$. (auth)

1752 THE ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF THE HO_2 RADICAL IN AQUEOUS SOLUTION. Eiichi Saito and Benon H. J. Bielski (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 83: 4467-8 (Nov. 5, 1961). (BNL-5664)

When a 0.001 M ceric sulfate solution was mixed with a 0.1 M solution of hydrogen peroxide at room temperature, an epr spectrum of what is believed to be the HO_2 free radical was found. The g for the species is 2.016 with a line width of 27 gauss. The magnitude of the spectrum is a function of the flow velocity as well as the concentration of solute in the solutions. When the flow of the solutions is stopped while in the cavity, the spectrum disappears rapidly. (P.C.H.)

1753 EXCHANGE OF HYDROGEN BETWEEN WATER AND THE HYDROBORATE ION. William L. Jolly and Robert E. Mesmer (Univ. of California, Berkeley). J. Am. Chem. Soc., 83: 4470-1 (Nov. 5, 1961).

The exchange of hydrogen between hydroborate ions and water in aqueous hydroborate solutions takes place by two different paths. The exchange rate corresponding to one path is independent of pH and is measurable at elevated temperatures in solutions of very high pH (14). The exchange corresponding to the other path is acid catalyzed and is detectable in solutions undergoing hydrolysis at ordinary temperatures. The pH-independent exchange reaction was studied by measuring the exchange between D_2O (99.82%) and potassium hydroborate (0.4 M) in solutions which were 1, 3, and 5 M in sodium deuteroxide and in which the ionic strength was brought to 5.4 M with sodium chloride. (P.C.H.)

1754 APPLICATION OF THE CZOCHRALSKI METHOD TO DIVALENT METAL FLUORIDES. K. Nassau (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 32: 1820-1 (Oct. 1961).

The Czochralski method of pulling from the melt was applied to the growth of single crystals of divalent fluorides of Ca, Sr, Ba, Co, and Mn, and the compound $KMnF_3$. The trivalent rare earth ions Ce, Nd, Sm, Eu, Gd, Tb, and Yb were introduced into CaF_2 and the distribution coefficient was determined to be close to unity in all cases. (auth)

1755 PREPARATION OF MONOCRYSTALLINE CUPROUS OXIDE. Yukiko Ebisuzaki (Indiana Univ., Bloomington). J. Appl. Phys., 32: 2027-8 (Oct. 1961).

A method is described for preparing large crystals of cuprous oxide by oxidation of monocrystalline copper. The initial oxidation is performed slowly at low oxygen pressure and temperature, to promote oriented growth of the oxide film. The cuprous oxide crystals obtained from the oxidation process show subgrain boundaries which are removed by subsequent annealing. (auth)

1756 TECHNETIUM DITHIZONATE. Tomiataro Ishimori, Eiko Nakamura, and Johkun Akatsu (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 767-9 (Oct. 1961). (In English)

In the presence of hydrazine or zinc metal, Tc^{99} tracer is extracted into chloroform or carbon tetrachloride solution of dithizone from 0.1 M nitric acid. On the other hand technetium is stripped with >4 M nitric acid or 0.1 M nitric acid containing hydrogen peroxide from the organic solution. Based on these facts, the formation of the dithizonate is newly confirmed. According to the dependence of the extractability for technetium, it is found that two dithizone anions are bound for each technetium cation in technetium dithizonate. (auth)

1757 ADSORPTION OF RADIOACTIVE IODINE VAPOR IN AIR STREAMS ON THE MOLECULAR SIEVES-5-A. Susumu Kitani and Hideo Ezure (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc., Japan, 3: 787-91 (Oct. 1961). (In English)

The results of an investigation of the removal of radioiodine vapor by means of adsorption on the Linde molecular sieves-5A are described. According to the results, water vapor works as a poison in the process except at high temperature. However, owing to their small efficiency at higher temperature, the molecular sieves-5A as an effective adsorbent should be employed at lower temperature together with proper water vapor adsorbents. Under the most suitable condition, it is possible to adsorb the vapor even at pressures as low as 10^{-6} mm Hg. (auth)

1758 TEMPERATURE-DEPENDENT CHEMICAL SHIFTS IN THE NMR SPECTRA OF GASES. L. Petrakis and C. H. Sederholm (Univ. of California, Berkeley). J. Chem. Phys., 35: 1174-8(Oct. 1961). (UCRL-9572)

It was found that the chemical shifts of various gaseous compounds, using gaseous methane as a standard, vary with temperature. The slopes of chemical shift versus temperature at 50°C are tabulated for several compounds. This effect is ascribed to excitation of vibrational modes of the molecules, the protons in the excited molecules being differently shielded than the protons in the ground vibrational states. The data are interpreted to yield approximate chemical shifts associated with the excitation of various types of modes. NMR isotopic shifts are discussed on the basis of these data. (auth)

1759 NUCLEAR CONTRIBUTION TO THE HEAT CAPACITY OF TERBIUM METAL. E. C. Heltemes and C. A. Swenson (Ames Lab., Ames, Iowa). J. Chem. Phys., 35: 1264-5(Oct. 1961). (IS-260)

The heat capacity of terbium metal was measured between 0.25 and 1.0°K. The high temperature data can be expressed as $C = 28R \times 10^{-3}/T^2$ cal/mole-deg. The data are compared with a Schottky formula for the heat capacity, assuming equal spacing between the nuclear hyperfine levels with an over-all spacing of $\Delta = 0.45°K$, corresponding to the high temperature expression above. The agreement is within experimental error except at the very lowest temperatures obtained. The effective field at the nucleus of the terbium atom can be calculated and is found to be $H_{eff} = 4 \times 10^6$ gauss. (auth)

1760 ZEEMAN EFFECT OF THE NUCLEAR QUADRUPOLE RESONANCE SPECTRUM IN CRYSTALLINE POWDER. Yonezo Morino and Masaharu Toyama (Tokyo Univ.). J. Chem. Phys., 35: 1289-96(Oct. 1961).

The Zeeman effect of the nuclear quadrupole resonance spectrum for spin $I = \frac{3}{2}$ in crystalline powder was studied. Theoretical considerations predicted that, in a nonaxial electric field gradient, the absorption line should be broadened with a characteristic envelope by a weak static magnetic field. When a radio-frequency (rf) field is applied parallel to the static field, one pair of sharp minima should be produced on the envelope at the frequencies shifted by $\pm\gamma H/2\pi$ from the unperturbed quadrupole resonance line, and two pairs of sharp maxima at $\pm(1-\eta)\gamma H/2\pi$ and at $\pm(1+\eta)\gamma H/2\pi$. Resonance spectra of Cl^{35} nuclei in p-dichlorobenzene and cyanuryl chloride clearly displayed the predicted shape of envelopes on a recorder at room temperature. Analysis of them resulted in determining the asymmetry parameters of electric field gradients with considerable accuracy; $0.07_0 \pm 0.01$ for the α-modification of p-dichlorobenzene, and 0.22 ± 0.03 for ν_1 line, and 0.23 ± 0.04 for ν_2 line of cyanuryl chloride. (auth)

1761 STRUCTURAL EFFECTS IN THE VAPOR PRESSURES OF ISOTOPIC MOLECULES. O^{18} AND N^{15} SUBSTITUTION IN N_2O. Jacob Bigeleisen and Slobodan V. Ribnikar (Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 35: 1297-1305(Oct. 1961). (BNL-5324)

The relative vapor pressure ratios of the isotopic N_2O molecules were determined by distillation in a column under total reflux. It is shown that the vapor pressures are in the sequence $N^{14}N^{14}O^{16} > N^{14}N^{15}O^{16} > N^{15}N^{14}O^{16} > N^{14}N^{14}O^{18}$. The absolute vapor pressure ratios were determined from the kinetic behavior of the column and the decrease in separation by production from the column. Theoretical calculations of the relative vapor pressure ratios can be made from the atomic masses and the random structure of liquid N_2O. The calculated relative isotope effects are in good agreement with experiment. The absolute value of $\ln P_{N^{14}N^{14}O^{16}}/P_{N^{14}N^{15}O^{16}}$ is calculated from the specific heat of N_2O to be 8.2×10^{-4} at 184°K and is in good agreement with the experimental value $7.8 \pm 1.4 \times 10^{-4}$. The difference in vapor pressures of the isotopic isomers $N^{14}N^{15}O^{16}$ and $N^{15}N^{14}O^{16}$ is attributed to hindered rotation of the molecule in the liquid. (auth)

1762 QUADRUPOLE COUPLING IN LITHIUM NITRATE. David H. Anderson (Sandia Lab., Albuquerque, N. Mex.). J. Chem. Phys., 35: 1353-7(Oct. 1961).

The value of the Li^7 quadrupole coupling constant in a single crystal of $LiNO_3$ was found to be 35.5 ± 0.2 kc. It is expected that a reliable estimate of the quadrupole moment of Li^7 may be made with the observed coupling constant and the point-charge field gradient, because of the good agreement for Na^{23} in the case of the isomorphous crystal $NaNO_3$. The value found in this manner is ±0.069 b. The $LiNO_3$ crystal was γ irradiated to facilitate the measurements, and a γ-irradiated crystal of $NaNO_3$ was studied for comparison. It appears that the broadening of the Na^{23} satellite lines in the irradiated $NaNO_3$ results from a relaxation process and not from a wide distribution of static field gradients, and it is concluded that γ irradiation has little or no effect on the Li^7 coupling constant in $LiNO_3$. A precise knowledge of the Li^7 quadrupole moment would provide a test of the ionic model in $LiNO_3$. (auth)

1763 ENERGY LEVELS OF $PrCl_3$. Jack S. Margolis (Atomics International, Canoga Park, Calif.). J. Chem. Phys., 35: 1367-73(Oct. 1961).

A review of the spectra of the Pr^{3+} ion in $PrCl_3$ is presented and the spectra are re-analyzed by means of a more complete Hamiltonian than was previously used. This new Hamiltonian includes a complete calculation of the crystalline field interaction for a field of D_{3h} symmetry, and the first-order calculation of the orbit-orbit, mutual spin-orbit, and spin-spin interactions, as well as the usual spin-orbit and mutual electrostatic interactions. The multiplet splitting and crystalline field splitting are treated separately according to a least-squares procedure; the standard deviation of the center of gravity of the multiplets is 200 cm^{-1} without the orbit-orbit interaction and 105 cm^{-1} with the orbit-orbit interaction. The values of F_2, F_4, F_6, ζ, and α are 305.4, 51.88, 5.321, 729.5, —, cm^{-1}, respectively, in the first case, and 307.9, 50.23, 5.033, 755.1, −0.6542,

cm^{-1}, respectively, in the second case. The standard deviation of the calculation for 40 of the crystalline field levels is 7 cm^{-1}. If the deviation of the $^1D_2$ levels, which fit the calculation particularly badly, are not included, the standard deviation is then only 4 cm^{-1}. The values of the crystalline field parameters are: A_{20} $(r^2) = 47.26$, A_{40} $(r)^4 = -40.58$, A_{60} $(r^6) = 39.62$, A_{66} $(r^6) = 26.67$ cm^{-1}. (auth)

1764 IONIZATION CROSS SECTIONS NEAR THRESHOLD BY ELECTRON IMPACT. R. E. Fox (Westinghouse Electric Corp., Pittsburgh). J. Chem. Phys., 35: 1379-82 (Oct. 1961).

Ionization curves near threshold were taken with a mass spectrometer employing a monoenergetic electron beam. These curves were fitted to previously published data from total ionization experiments in order to obtain absolute cross sections for the threshold energy region. Curves for helium, neon, argon, mercury, carbon monoxide, and nitrogen are given. (auth)

1765 ELECTRICAL PROPERTIES OF NONSTOICHIOMETRIC URANIUM DIOXIDE. S. Aronson, J. E. Rulli, and B. E. Schaner (Westinghouse Electric Corp., Pittsburgh). J. Chem. Phys., 35: 1382-8(Oct. 1961).

Electrical conductivity and thermoelectric power measurements were made on nonstoichiometric UO_2 at temperatures of 500−1150°C. The conductivity data in the single phase UO_{2+x} region can be represented by the equation $\sigma(\text{ohm cm})^{-1} = (3.8 \times 10^6)/T(2x)(1 - 2x) \exp[(-0.30 \pm 0.03 \text{ ev})/kT]$. An approximate equation for the thermoelectric power Q, is $Q = (k/e) \ln (1 - 2x/2x)$. The electrical measurements confirm the ionic theory of nonstoichiometry in UO_2, postulated on the basis of thermodynamic evidence. Nonstoichiometric UO_2 is a relatively simple ionic solid in which activated electronic hole transfer occurs between U^{5+} and U^{4+} ions in the lattice. (auth)

1766 ANALYSIS OF THE SPECTRA OF TRIVALENT PROMETHIUM AND HOLMIUM. M. H. Crozier and W. R. Runciman (Univ. of Canterbury, Christchurch, N. Z.). J. Chem. Phys., 35: 1392-1409(Oct. 1961).

The spin-orbit matrices for the f^4 configuration were calculated and checked. These were applied to the analysis of the solid-state spectra of trivalent promethium and holmium. A tentative energy level scheme for promethium is obtained. In the case of holmium, all levels below 27,000 cm^{-1} were identified, including two levels hitherto unreported in the solid state, at 25,900 cm^{-1} and 26,190 cm^{-1}, and a root mean-square deviation between calculated and observed energies of 96 cm^{-1} is achieved. Values of the Landé splitting factor g are predicted for the holmium levels. (auth)

1767 DIRECT FIELD EFFECTS IN ELECTRON PARAMAGNETIC RESONANCE HYPERFINE SPECTRA. John A. Weil (Argonne National Lab., Ill.) and John H. Anderson. J Chem. Phys., 35: 1410-17(Oct. 1961).

The electron paramagnetic resonance spectrum exhibiting hyperfine effects from one nucleus is discussed for the case when the nuclear spin interacts appreciably not only with the electron magnetic moment but also directly with the applied magnetic field. The predicted hyperfine structure consists, in general, of $2S(2I + 1)^2$ lines. The angular dependence of the intensities and splittings is investigated; nodes in the splitting are found to be possible even when the eigenvalues of the hyperfine splitting tensor are nonzero. When the direct-field interaction is large, $2I + 1$ principal hyperfine lines occur, flanked by weaker outrider lines. Another mechanism for producing outrider lines in high direct fields, the nuclear quadrupole interaction with an electric field gradient, is discussed. Magnetic resonance studies of color centers in germanium-doped quartz demonstrate some of the predicted effects. (auth)

1768 CALCULATIONS OF THE COEFFICIENT OF VISCOSITY AND THE COEFFICIENTS OF DIFFUSION FOR DISSOCIATING HYDROGEN. David G. Clifton (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 35: 1417-20 (Oct. 1961).

The kinetic theory of dilute monatomic gases and mixtures was used to calculate some transport properties of dissociated hydrogen. The H_2-H_2 and $H-H_2$ interactions were assumed to obey the modified Buckingham (exp-6) potential and the Lennard-Jones (12-6) potential, respectively, and the two H−H interaction potentials ($^1\Sigma_g$ and $^3\Sigma_u$) were treated by the method of Hirschfelder and Eliason to obtain a weighted average rigid-sphere collision diameter. The coefficient of viscosity, the coefficient of diffusion in a binary mixture of the $H-H_2$ system, and the coefficients of self-diffusion for H atoms and H_2 molecules were computed for temperatures from 1500 to 5000°K and pressures of 0.1, 0.5, 1, 2, 10, 50, and 100 atm. (auth)

1769 DIFFUSION OF NEON ISOTOPES IN FUSED QUARTZ. R. C. Frank, D. E. Swets, and R. W. Lee (General Motors Corp., Warren, Mich.). J Chem. Phys., 35: 1451-9(Oct. 1961).

The diffusion of Ne^{20} and Ne^{22} through the walls of high-purity fused quartz hollow cylinders was studied using a mass spectrometer as a detecting device. The diffusion process was found to be relatively simple and fairly well described by Fick's laws. Diffusion coefficients and permeabilities were measured for both isotopes in the temperature range of 440 to 985°C. The D_0's for Ne^{20} and Ne^{22} were $(2.21 \pm 0.12) \times 10^{-4}$ cm^2/sec and $(2.08 \pm 0.17) \times 10^{-4}$ cm^2/sec respectively. The activation energy for diffusion for Ne^{20} was 11,370 ± 80 cal/g atom and the value for Ne^{22} was found to be statistically equivalent to this. The best estimate of the ratio of the D_0's was 1.05 ± 0.01. Solubilities were calculated by dividing the permeabilities by the diffusion coefficients. The heats of solution for the two isotopes were the same and equal to −1950 ± 150 cal/g atom. The significance of the isotope effect in diffusion is discussed. (auth)

1770 NUCLEAR MAGNETIC RESONANCE IN $CuF_2 \cdot 2H_2O$ SINGLE CRYSTALS. R. G. Shulman and B. J. Wyluda (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 35: 1498-9(Oct. 1961).

The hydrogen and fluorine nuclear magnetic resonance signals were measured in single crystals of $CuF_2 \cdot 2H_2O$. The hyperfine interaction between the fluorine nucleus and the magnetic electrons was separated into isotropic and anisotropic components which were evaluated. The Néel temperature was determined to be 10.92 ± 0.2°K in contrast to the maximum in the susceptibility which was shown to occur at 26°K. (auth)

1771 CHEMIONIZATION IN THREE-BODY GAS PHASE REACTIONS. C. Gatz, F. T. Smith, and H. Wise (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys., 35: 1500-1(Oct. 1961).

An experimental study of the kinetics of charged particle production by simple exothermic chemical reactions was initiated in order to elucidate the mechanism of chemionization. Chemionization of cesium by homogeneous recombination of nitrogen atoms, $N + N + Cs \xrightarrow{k} N_2 + Cs^+ + e^-$, is energetically feasible. Nitrogen gas, partially dissociated in an electrodeless discharge, was passed through an orifice into a cylindrical reactor heated to 300°C. Cesium vapor was introduced into the reactor by sublimation from a heated side tube. From the linear flow rate and the net transport rate of cesium, the cesium vapor concentration was estimated to be 10^{13} atom/cm^3. The characteristic current-voltage curve was observed as a function of total gas pressure (2 to 5 mm) and atom density. The current appeared to saturate at about 30 v. (P.C.H.)

1772 CALCULATION OF METAL SURFACE TENSIONS. IONIC-SALT AND MONATOMIC METHODS FOR LIQUID METALS. S. W. Mayer (Atomics International, Canoga Park, Calif.). J. Chem. Phys., 35: 1513-14(Oct. 1961).

It was found that the surface tensions of molten metals can be calculated by using one of two models for the metal: an ionic-salt model or a monatomic model. The ionic salt-model was applicable to the alkali metals, alkaline earth metals, and metals of groups IV and V. The metals near the centers of the series of the periodic table were treated on the basis of the monatomic model. Surface tensions are given for K, Mg, Pb, Bi, and Sb, calculated by the salt model, and Zn, Cd, Hg, Cu, Ag, Au, Al, Ga, In, Tl, and Fe calculated by the monatomic model. Discussion is given on calculations by the two models. (P.C.H.)

1773 OPTICAL AND PARAMAGNETIC RESONANCE SPECTRA OF TRIVALENT Pu^{239} IN THE TRICHLORIDE AND ETHYLSULFATE. H. Lammermann and H. J. Stapleton (Univ. of California, Berkeley). J. Chem. Phys., 35: 1514-16(Oct. 1961).

The optical absorption and fluorescent spectra of trivalent Pu^{239} in $LaCl_3$ and $La(C_2H_5SO_4)_3 \cdot 9H_2O$ were investigated together with the paramagnetic resonance absorption of Pu^{239} in $LaCl_3$ at 3 cm wavelengths at 42°K. The optical spectra were taken at 77, 20, and 4.2°K on a grating spectrograph with a dispersion of 5 Å/mm. The magnetic quantum numbers of the three crystal field components, the observed energies, and the experimentally determined crystal field matrix elements using a first-order perturbation calculation are tabulated. There is a high-temperature shift in the ethylsulfate corresponding to a change of the lattice constants with temperature. The matrix elements of the concentrated Sm salts are given for comparison. The optical spectra and paramagnetic resonance absorption spectra of two Pu^{3+} doped $LaCl_3$ samples are also discussed. (P.C.H.)

1774 ASSOCIATION OF CARBON ATOMS FROM GRAPHITE IN A RADIO-FREQUENCY SPARK. William L. Baun and David W. Fischer (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). J. Chem. Phys., 35: 1518-19(Oct. 1961).

The phenomenon of clumping or association of more than one carbon atom in ionized states was observed in graphite mass spectra. When a strong exposure is made on a photographic plate from a high-frequency spark between graphite electrodes, a series of positive ion doublets (due to C^{12} and C^{13}) was seen across the plate beginning at C_1^+ and continuing to C_{28}^+ (which is a charged molecule containing 28 carbon atoms). A plot of intensity as a function of the number of carbon atoms in the ionized molecule is compared with a previously published work. The data show minima occurring at even masses between C_4^+ and C_8^+. Then at C_{10}^+, every fourth even mass is a maximum in that portion of the curve on through to C_{26}^+. (P.C.H.)

1775 RATE OF COOLING IN A MAGNETIC FIELD. Donald D. Fitts (Univ. of Pennsylvania, Philadelphia). J. Chem. Phys., 35: 1519-20(Oct. 1961).

The work was undertaken to show that the energy transport equation in conjunction with the usual linear relation for heat flow as postulated in the macroscopic theory of irreversible processes is adequate to describe the experiment in which the cooling rate of liquid mercury and liquid water was measured in a constant magnetic field of 23000 gauss and in the absence of this field. The equation $\ln (T - T_0) = -(A/\rho VC_v)\,(k - \frac{1}{2}\,K\chi H^2)t +$ const is the derived expression for the cooling curve for a system with the properties stipulated. The rate of cooling is $(A/\rho VC_v)\,(k - \frac{1}{2}K\chi H^2)$. Since χ is negative for a diamagnetic substance, the cooling rate increases when the system is placed in a magnetic field. Thus, the equation agrees qualitatively with experiment. (P.C.H.)

1776 SUBSTITUTION OF A CATALYTIC PROBE FOR A TUBE OF INFINITE LENGTH IN ATOM RECOMBINATION EXPERIMENTS. Bernard J. Wood and A. Bruce King (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys., 35: 1530-1(Oct. 1961).

As a means of evaluating the recombination efficiency of atoms on a tube wall, data derived from a system in which the heat flux into a movable probe of finite catalytic activity was employed as the measure of atom concentration n(L,L) at various probe distances L from the source were used. The condition when the net atom flux through a plane at x = L in the infinite tube equals that to the surface of the closure at x = L, and the atom concentrations at x = L are the same for both tubes or $F(L,\infty) = F(L,L)$ and $n(L,\infty) = n(L,L)$ was examined. It was concluded that catalytic probe measurements taken at sufficient distances from the origin may be used to evaluate the wall activity. (P.C.H.)

1777 ABSENCE OF B^{10}—B^{11} COUPLING IN B_4H_{10}. John S. Rigden, Robert C. Hopkins, and John D. Baldeschwieler (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 35: 1532-3(Oct. 1961).

The B^{11} NMR spectrum of B_4H_{10} at 15.1 mc does not show a septet structure on the BH doublet. The BH doublet is better described as a poorly resolved triplet. Upon double irradiation at the B^{10} resonance frequency, the structure on the group is not changed. Thus the fine structure cannot be assigned to B^{10}—B^{11} coupling between the 1 and 3 boron atoms. The spectrum of B_4H_{10} is also shown and discussed. (P.C.H.)

1778 LONG RANGE $N^{14} - H^1$ NUCLEAR RESONANCE COUPLING IN ISONITRILES. I. D. Kuntz, Jr., P. von R. Schleyer, and A. Allerhand (Princeton Univ., N. J.). J. Chem. Phys., 35: 1533-4(Oct. 1961).

In the course of routine measurements of the chemical shift of the hydrogens in t-butyl isonitrile, splitting of the proton resonance was observed. It is believed that this represents the first case of a resolvable long range N^{14}—H^1 interaction. Several other isonitriles, methyl isonitrile, benzyl isonitrile, isopropyl isonitrile, butyl isonitrile, tert-butyl isonitrile, and cyclohexyl isonitrile, were examined and the same results were obtained. The fact that splitting is observed with isonitriles indicates that the spin-lattice relaxation time of N^{14} must be comparable to the coupling constant. The low electric field gradient must be due to the axial symmetry of the electron density near the nitrogen atom. (P.C.H.)

1779 AN INFRA-RED SPECTROSCOPIC INVESTIGATION OF THE NATURE OF THE HYDROGEN HALIDE IN TRANSDICHLORO BIS ETHYLENEDIAMINE COBALT(III) CHLORIDE, HYDROCHLORIDE DIHYDRATE; AND THE BROMIDE ANALOGUE. N. F. Curtis (Victoria Univ., Wellington). J. Inorg. & Nuclear Chem., 19: 208-11(Oct. 1961). (In English)

Comparison of the infrared spectra of trans dichloro bis ethylenediamine cobalt(III) as the chloride and as the chloride hydrochloride dihydrate, and of trans dibromo bis ethylenediamine cobalt(III) as the bromide and as the bromide hydrobromide dihydrate indicates the presence of the hydroxonium ion in the hydrohalides, showing that the hydrogen halide is present in the ionized form H_3O^+, X^-. (auth)

1780 HIGH-PRESSURE HIGH-TEMPERATURE INVESTIGATION OF THE URANIUM—OXYGEN SYSTEM. W. B. Wilson (Battelle Memorial Inst., Columbus, Ohio). J. Inorg. & Nuclear Chem., 19: 212-22(Oct. 1961). (In English)

An investigation was made of the effects of combined ultrahigh pressure and high temperature on the oxides of uranium with particular emphasis on U_3O_8. A new polymorph of U_3O_8, designated γ-U_3O_8, occurs at pressures in excess of 16000 atm at temperatures above 400°C. At 60000 atm the gamma U_3O_8 co-exists with a cubic U_4O_9-like phase. These results, although of a preliminary nature, show that the uranium—oxygen phase diagram is greatly modified by the effects of pressure. (auth)

1781 THE INDIUM(I) BROMIDE—INDIUM(III) BROMIDE SYSTEM. P. H. L. Walter, J. Kleinberg, and E. Griswold (Univ. of Kansas, Lawrence). J. Inorg. & Nuclear Chem., 19: 223-8(Oct. 1961). (In English)

A cryoscopic phase study of the system indium(I) bromide—indium(III) bromide was made. Evidence was found for the existence of three intermediate compounds: In_2Br_3, In_4Br_7, and $InBr_2$. The results of the phase study were verified by x-ray powder patterns and by an extraction experiment. In the light of Pauling's radius ratio theory and previous work on indium halides, it is postulated that In_2Br_3 exists as $In^I_3[In^{III}Br_6]$ and that $InBr_2$ exists as $In^I[In^{III}Br_4]$. No structure is proposed for In_4Br_7. (auth)

1782 STRUCTURAL EVIDENCE ON THE BERYL—SODIUM FLUOROSILICATE REACTION. K. R. Hyde, P. L. Robinson, M. J. Waterman, and J. M. Waters (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 19: 237-44(Oct. 1961). (In English)

An x-ray examination was made of the products of the reaction of beryl with sodium fluoride, silicon tetrafluoride, and sodium fluorosilicate. The evidence, in conjunction with that from chemical analysis, enabled certain stages in the reaction of beryl with sodium fluorosilicate to be recognized. The first of these leads to a soluble fluoroberyllate, cryolite, and cristobalite, and the second to the felspar albite. The third stage, occurring when all the beryl is destroyed, produces albite, sodium fluoride, and silicon tetrafluoride by a reaction between cryolite and cristobalite. The albite incorporates beryllium ions in its lattice and these cease to be extractable by water. (auth)

1783 A DIFFERENTIAL THERMAL ANALYSIS STUDY OF THE DEHYDRATION OF THE RARE-EARTH(III) SULPHATE HYDRATES. THE HEATS OF DEHYDRATION. W. W. Wendlandt and T. D. George (Texas Technological Coll., Lubbock). J. Inorg. & Nuclear Chem., 19: 245-50 (Oct. 1961). (In English)

The dehydration of the rare-earth sulfate hydrates, $M_2(SO_4)_3 \cdot nH_2O$, was studied by the methods of differential thermal analysis (DTA). The lighter rare earths, lanthanum through samarium, all gave three endothermic dehydration peaks, while with the heavier elements, with the exception of ytterbium, only two peaks were observed. The lighter rear earths were completely dehydrated below 350°C while for the heavier rare-earth salts, the dehydration process was completed below 300°C. The heats of dehydration were determined by integration of the DTA curve peaks. The heats of dehydration ranged from 68 to 152 kcal/mole^{-1}; the former for $Ce_2(SO_4)_3 \cdot 5H_2O$, and the latter for $Yb_2(SO_4)_3 \cdot 11H_2O$. (auth)

1784 NEGATIVE CHELATE COMPLEXES OF LANTHANIDE AND ACTINIDE ELEMENTS. L. W. Holm (Research Inst. of National Defense, Stockholm), G. R. Choppin, and D. Moy. J. Inorg. & Nuclear Chem., 19: 251-61(Oct. 1961). (In English)

Ion exchange and electrophoretic studies of the glycolic, lactic, and α-hydroxy isobutyric acid—lanthanide and actinide systems show the presence of negative mononuclear complexes in solutions at ligand ion concentrations above 0.1 $\underline{M}$. These negative complexes are monovalent with four ligands attached to the central atom. (auth)

1785 THE URANIUM(IV) COMPLEXES WITH 8-QUINOLINOL AND 5,7-DIHALO-8-QUINOLINOLS. W. W. Wendlandt and G. R. Horton (Texas Technological Coll., Lubbock). J. Inorg. & Nuclear Chem., 19: 272-7(Oct. 1961). (In English)

The preparation of the 5:1 uranium(IV) complexes of 8-quinolinol, 5,7-dibromo-, and 5,7-dichloro-8-quinolinol is presented. By the use of thermogravimetric analysis, differential thermal analysis, and ultraviolet, visible, and infrared absorption spectroscopy, it was shown that the resulting complexes were similar to the thorium(IV) analogues of these chelating agents. It does not appear to be possible to prepare the unsolvated, 4:1 uranium(IV) complexes. (auth)

1786 A STUDY OF TRANSFERENCE AND SOLVATION PHENOMENA. IV. POTASSIUM CHLORIDE IN WATER AND WATER—ETHANOL SOLVENTS. J. O. Wear, C. V. McNully, and E. S. Amis (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 19: 278-85(Oct. 1961). (In English)

Transference and solvation phenomena for the ions of potassium chloride in water and water—ethanol solvents were studied. The transference numbers of the anion as a function of salt concentration and solvent composition are presented graphically. The sine-like curve for the solvent transferred from anode to cathode is discussed in relation to the relative solvation and the nature of solvation of the potassium and chloride ions. (auth)

1787 A STUDY OF THORIUM—IODATE COMPLEXING IN AQUEOUS SOLUTIONS. R. W. Stoughton, A. J. Fry, and J. E. Barney, II (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 19: 286-97(Oct. 1961). (In English)

Thorium—iodate complexing at 25°, ionic strength of 0.5 and pH 2.6, was studied by means of solubility measurements. While the solid phase showed no evidence of crystal structure and under some conditions varied somewhat in composition with solution composition, the observed solubilities were reproducible. The data were interpreted in terms of the species $Th(IO_3)_8^{4-}$, $Th(IO_3)_6^{2-}$, $Th(IO_3)_3^{+}$, $Th(IO_3)_2^{2+}$, $ThIO_3^{3+}$, $ThOH(IO_3)_2^{+}$, and $ThOHIO_3^{2+}$, and the corresponding stability quotients derived. There was no evidence for the existence of the intermediate species $Th(IO_3)_7^{3-}$, $Th(IO_3)_5^{-}$, and $Th(IO_3)_4$. (auth)

1788 EXCHANGE PROPERTIES OF AMMONIUM SALTS OF 12-HETEROPOLYACIDS. II. SEPARATION OF RUBIDIUM AND CAESIUM ON AMMONIUM PHOSPHOTUNGSTATE. J. Krtil (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). J. Inorg. & Nuclear Chem., 19: 298-303(Oct. 1961). (In English)

The separation of rubidium and cesium on a column of freshly-precipitated ammonium phosphotungstate (NH_4PW)

and asbestos carrier was investigated; rubidium may be eluted with 1 N ammonium nitrate and cesium with 6 N ammonium nitrate. The exchange capacity of NH_4PW for cesium and rubidium corresponds to two thirds of the theoretical ammonium content, and the exchange of ammonium for cesium and rubidium is quantitatively expressed by the mass action law at micro-levels. (auth)

1789 THE PREPARATION AND PROPERTIES OF TcF_6. Henry Selig, Cedric L. Chernick, and John G. Malm (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 19: 377(Oct. 1961). (In English)

The reaction of fluorine gas and technetium metal powder yields a volatile compound which was identified as TcF_6. Two preparations were made using 85 and 236 mg samples of Tc metal. The yield of purified TcF_6 was greater than 90%. At room temperature the compound is a golden yellow solid. The melting point determined in a thin-walled capillary was 33°C. Upon hydrolysis with NaOH, TcF_6 yields a black precipitate which dissolves with the addition of H_2O_2. Some preliminary vapor pressure measurements are given for solid TcF_6. (P.C.H.)

1790 THE BASICITY OF AMINO ACIDS IN D_2O. H. H. Hyman, Arlene Kaganove, and J. J. Katz (Argonne National Lab., Ill.). J. Phys. Chem., 64: 1653-5(Nov. 1960).

The basicity of a number of amino acids in D_2O was measured by a spectrophotometric method. For simple amino acids, the apparent ionization constant is approximately 0.5 pK unit higher in D_2O than in H_2O. (auth)

1791 ν_2 AND ν_4 BANDS OF THE NT_3 MOLECULE. K. Narahari Rao (Ohio State Univ., Columbus) W. W. Brim, J. M. Hoffman, Llewellyn H. Jones, and Robin S. McDowell. J. Mol. Spectroscopy, 7: 362-83(Nov. 1961).

The ν_4 and ν_2 bands of the NT_3 molecule located at 10 and 15 microns were recorded with a high resolution vacuum grating spectrometer. Rotational constants were determined from an analysis of the band ν_4. These data were then combined with published data on the NH_3 and ND_3 molecules to calculate the ground-state energy levels of NT_3. Giant l-type doubling was observed in the band ν_4 and the doubling constant, q, was calculated. From the observations on ν_2 it is evident that the inversion splitting of the first excited state of ν_2 is about 0.8 cm^{-1}. (auth)

1792 APPARATUS FOR DETERMINATION OF PRESSURE-DENSITY-TEMPERATURE RELATIONS AND SPECIFIC HEATS OF HYDROGEN TO 350 ATMOSPHERES AT TEMPERATURES ABOVE 14°K. Robert D. Goodwin (National Bureau of Standards, Boulder, Colo.). J. Research Natl. Bur. Standards, 65C: 231-43(Oct.-Dec. 1961).

A method and apparatus are designed for more rapid determination of accurate, closely-spaced, PVT, and specific heat data than realized by previous procedures. A sequence of pressure-temperature observations at nearly constant density is made by a modified Reichsanstalt method. Temperatures of the essentially adiabatic piezometer are regulated by electric heating under control of the measuring thermometer. Instruments for measurement and control are integrated with a high-pressure calorimeter for compressed liquid and fluid. Calorimetric experimentation is accelerated by use of an electronic battery for the calorimetric heat supply and of a d-c power regulator developed for automatic shield control. Details are given of the PVT calibrations, adjustment computations, and comparisons with independent data. (auth)

1793 INFRARED SPECTROSCOPIC STUDY OF ISOTOPIC EXCHANGE WITH SURFACE HYDROXYLS OF CHEMICALLY MODIFIED SILICAS. V. I. Lygin and A. V. Kiselev (Moscow State Univ.). Kolloid. Zhur., 23: 299-303 (May-June 1961). (In Russian)

Exchange of surface OH groups for OD in unmodified aerosil and aerosil containing trimethylsilyl groups on the surface was investigated with the aid of infrared spectroscopy. The trimethylsilyl groups of modified aerosil specimens perturb the hydroxyl groups remaining on the surface, which prevents the reaction of part of these groups with D_2O molecules. (auth)

1794 A FAST SIMPLE METHOD FOR ULTRAHIGH VACUUM. Fritz Kirchner (Universität, Cologne). Naturwissenschaften, 48: 548-9(1961). (In German)

A simple method for obtaining ultrahigh vacuum is presented. It is based on the astonishingly high getter effects of silicon monoxide evaporating in high vacuum. Starting with a usual high vacuum, a glass apparatus can be evacuated to 10^{-9} Torr within a few minutes without heating the apparatus. The quantity of SiO evaporated was so low that the walls of the tube remained unclouded. Similar evacuations can be made in metal chambers. It was concluded that the pressure-decreasing effect of the SiO depends on the getter property of the compound and also on the gas release from the vessel walls caused by the cladding effect of the SiO layer. (J.S.R.)

1795 HYPERFINE INTERACTION DUE TO ORBITAL MAGNETIC MOMENT OF ELECTRONS WITH LARGE g FACTORS. Y. Yafet (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. and Chem. Solids, 21: 99-104(Oct. 1961). (In English)

The hyperfine interaction due to the orbital magnetic moment of conduction electrons is investigated. The effect can be split into two parts. One part is due to the long-range component of the interaction and it depends only on the macroscopic properties of the solid, the magnetic susceptibility. This part depends on the shape of the sample via the demagnetizing factors; its magnitude is small, but the effect may be observable in a substance with very large g factor. The second part arises from the short-range component of the interaction and is the analogue of the atomic orbital hyperfine interaction; it reduces to it when the atoms are separated. (auth)

1796 A NOTE ON NICKEL HYDRIDE. T. Boniszewski and G. C. Smith (Cambridge Univ., Eng.). Phys. and Chem. Solids, 21: 115-18(Oct. 1961). (In English)

Evidence is given for the existence of fcc nickel hydride. The hydride can be obtained at room temperature by saturating nickel with hydrogen, using cathodic charging. The crystal structure was determined by indexing the diffraction patterns. Taking α = 3.524 Å the parameter of the nickel hydride is β = 3.721 ± 0.001 Å at 16 to 22°C. This corresponds to a 5.6% increase in lattice parameter during transformation to the hydride. The rate of decomposition of the hydride depends on temperature, size of crystallites (determined by the grain size of the parent metal), and the amount of deformation the specimen undergoes during handling. Photographs are given which show the decomposition at various time intervals. (P.C.H.)

1797 THE LOW TEMPERATURE SPECIFIC HEAT OF SCANDIUM AND YTTRIUM. H. Montgomery and G. P. Pells (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 78: 622-5(Oct. 1, 1961).

Specific heat measurements were made at 1.7 to 4.2°K. The specimen was cooled by a mechanical heat switch and exchange gas was used only for the thermometer calibration at the end of the run. Measurements on the scandium were repeated using a different heater and carbon thermometer, and at all temperatures the two determinations agreed to within 10%. Results are presented in tabular and graphical form. (L.N.N.)

1798 CHEMICAL REACTIONS AT VERY LOW TEMPERATURES. A ROTATING CRYOSTAT FOR MIXING REACTANTS AT 4.2°K. A. Thomas (U. S. National Bureau of Standards and Thornton Research Centre). Trans. Faraday Soc., 57: 1679-85(Oct. 1961).

It is not normally possible to conduct free radical-reactions so that only a single elementary step in the reaction sequence takes place, because the products of reaction are extremely reactive. In an attempt to control these reactions more closely and to preserve the very reactive radical chain carriers as products of primary reaction, a novel reactor is designed and constructed for use at the temperature of liquid helium. The two participants in a reaction are laid down as alternate solid layers on top of each other; the more reactive species being deposited as a fraction of a monolayer sandwiched between several monolayers of the less reactive material. The reactants are condensed on the outside surface of a spinning refrigerated drum to produce multilayer deposits about 0.1 to 0.5 mm thick, which are then examined by reflection spectroscopy. Preliminary results suggested that HCO is preserved when hydrogen atoms are deposited between layers of solid carbon monoxide. A reaction product absorbing continuously in the ultra-violet is found when hydrogen atoms are interspersed between layers of oxygen molecules. (auth)

1799 CATALYTIC EXCHANGE OF n-HEXANE AND DEUTERIUM AND SOME ALLIED REACTIONS ON FILMS OF PALLADIUM AND RHODIUM. F. G. Gault and C. Kemball (The Queen's Univ., Belfast). Trans. Faraday Soc., 57: 1781-94(Oct. 1961).

The exchange of deuterium with propane, n-pentane and n-hexane was followed using a mass-spectrometric technique on evaporated films of palladium and the reaction with n-hexane was also studied on rhodium films. The initial distributions of products provided evidence that an $\alpha\beta\gamma$-triadsorbed intermediate played a part in the mechanisms, in addition to the monoadsorbed and $\alpha\beta$-diabsorbed alkanes already known to be involved in the exchange reactions of hydrocarbons. Alternative mechanisms of exchange operated on rhodium including the direct formation of diadsorbed-hexane. Above 100° on palladium, or at 0° or above on rhodium, the hydrocarbons underwent further dissociation to form strongly adsorbed species which poisoned the exchange reactions. Some of these species could be reversibly hydrogenated but others could only be removed by hydrogenolysis to methane. The effect of oxygen or diethyl ether, as poisons for the exchange of hexane and deuterium, was examined on both metals and interpreted. (auth)

1800 THE SOLUBILITY PRODUCT OF ETHYLENEDIAMINETETRAACETIC ACID. G. S. Tereshin and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zhur. Anal. Khim., 16: 523-6(Sept.-Oct. 1961). (In Russian)

A value for the solubility product of ethylenediaminetetraacetic acid was determined by published solubility data. At 25° Lp is equal to 1.45×10^{-25}. It was shown by calculations that there are two products of the successive addition of protons to the EDTA molecule: H_5Y^+ and H_6Y^{2+}. Their dissociation constants were estimated (at 25°) to be $pk = 1.25$ and $pk_{00} = 0.66$. (auth)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 1360 and 2092

1801 (AF-SAM-61-85) THE EFFECT OF GAMMA RADIATION ON VISCOSITY AND ENZYMATIC ACTIVITY OF UREASE SOLUTIONS. E. Anne Dickens and Bernard Shapiro (Albert Einstein Medical Center. Radiology Dept., Philadelphia). Apr. 20, 1961. 7p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

The effects of γ irradiation up to 750 kr on urease solutions; on urease solutions containing the disulfide $[(GES)_2]$ of 2-guanidoethyl mercaptan (GESH); and on solutions containing the mixed disulfide of urease and GESH (urease-SEG) are studied. The extent of the irradiation effects is measured by changes in the viscosities and enzymatic activities of the solutions upon irradiation. The protective effects of $(GES)_2$ and GESH against radiation are examined. (T.F.H.)

1802 (ASD-TR-7-840A(III)) HYDRAZINE PROCESS DEVELOPMENT. Interim Technical Engineering Report, August–October 1961. J. H. Cusack, L. G. Carpenter, R. I. Miller, R. L. Pearson, F. R. Standerfer, and H. T. Watanabe (Aerojet-General Nucleonics, San Ramon, Calif.). Nov. 1961. Contract AF33(600)-42996. 172p.

Activities in a program to develop fissio-chemical production techniques for hydrazine are summarized. In process development, a 2000-sq ft facility was completed, and evaluation of hydroclone fuel separators continued. In materials development, the fabrication of slurry test toroids is about complete and compatability tests are planned. Plans for further research are presented, and a progress evaluation program network diagram which illustrates progress to date is included. (J.R.D.)

1803 (BNL-5755) ECONOMICS OF FISSION NEUTRON AND GAMMA CHEMO-NUCLEAR REACTORS FOR PRODUCTION OF ETHYLENE GLYCOL AND PHENOL. Meyer Steinberg and Leon Green (Brookhaven National Lab., Upton, N. Y.). Oct. 1960. Contract [AT(30-2)-Gen-16]. 11p.

Design and economics of a neutron-gamma radiation processing reactor for the production of ethylene glycol and phenol are discussed. The technical problems to be solved in liquid phase processing by fission neutron-gamma reactors are outlined. Ethylene glycol can be produced from methanol by fission neutron-gamma and fission recoil radiations in an endothermic reaction. Phenol can be produced from benzene in an aqueous liquid phase partial oxidation process using gamma radiation in an exothermic reaction. It was concluded that fission neutron and gamma chemonuclear reactors for low G value reactions require unreasonably large reactor capacities for tonnage chemical production. Even for the higher G value phenol process estimated costs were still higher than present conventional costs. (M.C.G.)

1804 (GEMP-101) A METHOD FOR COMPUTING PRIMARY KNOCK-ON SPECTRA AND POPULATIONS IN POLYATOMIC MATERIAL IRRADIATED BY NEUTRONS. J. R. Beeler and J. L. McGurn (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Oct. 1961. Contract AT(40-1)-2847. 30p.

Program 0659 computes the primary knock-on energy spectrum and number of primary knock-ons for each of five or less elements in a neutron-irradiated solid. The irradiated specimen may be either a slab of finite thickness and infinite area, an infinite cylinder or a parallelepiped. The energy dependence of neutron scattering anisotropy in the center of mass coordinate system is accounted for. An arbitrary neutron source in energy and direction and position may be used in a Program 0659 computation and any number of forced collisions can be specified. This program is written for the IBM 7090 computer in FAP language. (auth)

1805 (NAS-NS-3048) THE RADIOCHEMISTRY OF POTASSIUM. W. T. Mullins and G. W. Leddicotte (Oak Ridge National Lab.). 1961. Contract W-7405-Eng-26. 57p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

Information on the radiochemistry of K is presented. Included are a review of radiochemical features, a discussion of sample dissolution and counting, and a collection of radiochemical procedures for the element. (J.R.D.)

1806 (NP-10912) RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 6, May, June, and July [1961]. Hartmut Kallmann (New York Univ., New York). Aug. 1961. Contract DA 36-039 SC-85126. 33p.

The fluorescence decay times in solution of four substituted p-oligophenylenes are reported. The times are found to be shorter than those of other efficient scintillator solutes. Mixed crystals containing naphthalene, durene, and biphenyl as host substances and anthracene, naphthalene, terphenyl, and biphenyl as guest substances, are prepared. Several clear or almost clear crystals with less than 0.5 weight percent initial dosage of guest substances are obtained for each combination. Distributions of concentrations in the mixed crystals are not homogeneous but increase gradually from the bottom to the top. The middle parts have almost homogeneous concentration but their values are much less than the average concentrations. Emission spectra are measured on anthracene-in-naphthalene crystals of various concentrations. Conductivity and light experiments are carried out on CaF_2 ZnS(Cu), and ZnS(Ag) phosphors. The data for the ZnS phosphors at room and liquid nitrogen temperatures include glow curves (both luminescence and conductivity), emission spectra, and dependence of light and conductivity of x-ray intensity. For the CaF_2 phosphor, glow curves of luminescence and conductivity are obtained. However, the magnitude of the CaF_2 conductivity is appreciably below that in ZnS phosphors, and d-c measurements with high fields are required. (auth)

1807 (NP-10955) RADIATION INACTIVATION OF INTRACELLULAR TRANSFORMING DEOXYRIBONUCLEIC ACID (thesis). Johan Harrie Stuij (Utrecht. Rijksuniversiteit). [1961]. 91p.

A study was conducted to obtain information on radio-induced damage in intracellular deoxyribonucleic acid (DNA) and repair of this damage in the cell. The study method involved observations concerning the transfer of genetic properties from one kind of bacterial cell to another by means of extracted DNA. An analysis of results is included. (J.R.D.)

1808 (TID-12849) PROGRESS REPORT [ON] NUCLEAR CHEMISTRY RESEARCH AT CARNEGIE INSTITUTE OF TECHNOLOGY, 1960-1961. Truman P. Kohman and Albert A. Caretto, Jr. (Carnegie Inst. of Tech., Pittsburgh). June 15, 1961. Contract AT(30-1)-844. 102p.

Progress in the nuclear chemistry research program is described. Topics covered include a systematic study of (p,xp) reactions between 100 and 400 Mev; excitation functions of light mass nuclides from targets in the mass region A = 25 to 60; the (p,n) reaction at 100 to 400 Mev; (p,2N) reactions; recoil behavior of the Cu^{65}(p,pn)Cu^{64} reaction; the Al^{27}(p,3pn)Na^{24} monitor reaction excitation function; cross section measurements of some long-lived radionuclides from oxygen, silicon, and a few first-row elements; the nuclides Cr^{56} and Ti^{52}; neutron-rich isotopes of hafnium; Sb^{129} branching ratio; cosmogenic C^{14} and Cl^{36} in iron meteorites and C^{14} in stones; cosmic-ray produced x-ray emitters in stone meteorites; electron-capture nuclides produced in iron meteorites by cosmic rays; cosmic-ray-induced radioactivity in meteorites; production of Co, Mn, Cr, and V in thick iron targets by 440-Mev protons simulating meteorite exposure to cosmic rays; effects of "pseudo-diffusion" in marine sediments on the ionium dating method; possible U^{235} dating method for minerals; preparation of tellurium targets by electrodeposition; separation of iodine from tellurium targets; graphical method for determination of nonlinearity corrections of counters; and feasibility of reactor production of K^{40} for tracer use. (M.C.G.)

1809 (TID-14086) POLYMERIZATION IN THE CRYSTALLINE STATE. II. ALKALI ACRYLATES AND METHACRYLATES. H. Morawetz and I. D. Rubin (Brooklyn. Polytechnic Inst. Polymer Research Inst.). [1961]. Contract AT(30-1)-1715. 33p.

Alkali acrylates and methacrylates were irradiated with gamma rays at −78°C and their subsequent polymerization was studied *in vacuo* at 0 to 155°C. Potassium acrylate proved to be the most rapidly polymerizing solid monomer studied; it reacted at 0°C faster than the lithium salt at 101°C or the sodium salt at 120°C. The reaction rate of the acrylates decayed rapidly at low polymer yields which were, for long polymerization times, linear in the logarithm of time. The activation energy for the polymerization of potassium acrylate was 16.7 kcal/mole. The chain length of the polymer was, in all kinetic runs except one, independent of the polymer yields and was an order of magnitude higher for potassium acrylate than for the sodium or the lithium salt. Sodium methacrylate was more reactive than potassium methacrylate; the lithium salt of methacrylic acid was entirely inert. The sodium methacrylate polymerization had an initial accelerating phase. Studies of x-ray diffraction of the polymerizing potassium acrylate showed only minor changes in the diffraction pattern of the monomer, with the size of the unit cell remaining almost unchanged. Poly-(potassium acrylate) produced in the solid state showed four diffuse diffraction rings which were not observed in samples prepared from poly(acrylic acid) obtained by polymerizing a benzene solution of the monomer. While the x-ray data indicated the existence of a separate polymer phase in the polymerizing salts, the pronounced difference in the characteristics of the polymerization process of different salts of the same monomeric anion pointed to a control of the reaction by the geometry of the crystal lattice. The evidence suggests that the polymer lies in an amorphous phase but that the reactive ends of growing chains are anchored in the monomer lattice. Electron spin resonance spectra are similar for irradiated potassium acrylate and sodium methacrylate, but the potassium acrylate spectrum changes gradually from a three peak to a single peak structure when the sample is heated to 100°C, while the other two salts have spectra which are not affected by a similar heating cycle. The absence of the characteristic ESR spectrum of polymethacrylate radicals in irradiated sodium methacrylate suggests that under the experimental conditions used few of the primary radicals were able to initiate chains. A five-peak ESR spectrum was observed in irradiated sodium acrylate. (auth)

1810 (TID-14243) THE ROLE OF LIGHT IN THE SYNTHESIS OF LIPIDS IN FRUITS (thesis). Nadhim Showki Abdul Wahab, Jr. (Arizona. Univ., Tucson). 1960. Contract [AT(11-1)-262]. 65p.

Developing flax (*Linum usitatissimum* L.) embryos cultured *in vitro* were used for the study of the role of light in fat synthesis. White light and biotin in combination were absolute requirements for maximum incorporation of carboxyl-labeled acetate in lipids. Light not only enhanced fat synthesis, but inhibited the conversion of labeled acetate into CO_2. Adenosine triphosphate (ATP) and biotin were necessary for fat synthesis in embryos maintained in the dark in order to bring the specific activity of fat to that obtained in the light without the addition of these cofactors. The results indicated that light may generate ATP through photosynthetic phosphorylation. Only blue and red light were effective in stimulating fat synthesis from labeled acetate. The addition of reduced diphosphopyridine nucleotide (DPNH) to the culture increased fat synthesis and CO_2 evolution 2 to 3-fold. On the contrary, reduced triphosphopyridine nucleotide (TPNH) and coenzyme A had slight inhibitory effects. Malonate, in the absence of carboxyl-labeled acetate, enhanced the synthesis of fat. This suggested that malonic acid at low concentrations can serve as a precursor for the synthesis of long-chain fatty acids. Furthermore, light affects the type of fatty acids formed in flax embryos and increases the degree of unsaturation. Under light conditions, di- and trienoic acids are the dominant fatty acids. The stimulatory effect of low intensity red light on fat synthesis can be reversed by far-red light. This effect of red light on the utilization of acetate for fat synthesis cannot be reversed by far-red light after an hour and a half. It is concluded that red and far-red light, of relatively low intensity, can shift the use of acetate metabolism in one direction or another. (auth)

1811 (AEC-tr-4564) CHEMICAL EFFECTS OF GAMMA RAYS ON AQUEOUS SOLUTIONS OF SEVERAL COMPOUNDS OF NITROGEN. Xavier Tarrago. Translated from Ann. chem. (Paris), 5: 5-64(1960). 55p.

A study was made of the effects of gamma rays on aqueous solutions of nitrogen compounds in which the mechanisms of the reactions were considered. Radiolysis of hydroxylamine results in the formation of nitrogen, ammonia, and, at certain pH's, in N_2O; the decomposition yield at pH 6 is 8.1 molecules per 100 ev. In the presence of oxygen, hydroxylamine produces nitrates. The kinetic study of the hydroxylamine radiolysis permitted the development of an analytical expression in agreement with the curves obtained as a function of the absorbed dose, and of proposals for various steps in the oxidation of hydroxylamine to nitrogen and hyponitrous acid. Gamma rays cause hyponitrous acid to convert to nitrogen and oxygen. Irradiations were made of mixtures of hydroxylamine, nitrites, and nitrates in the presence and absence of air and H_2SO_4 to provide information on the mechanisms of the reactions. The products formed were measured and used to confirm hypotheses explaining the radiolytic decomposition of hydroxylamine, and the action of ionizing radiation on nitrites and nitrates. In neutron pH solutions values were determined for the radiolytic yield of water, formation of OH radicals, and H atom formation from hydrogen and H_2O_2. (B.O.G.)

1812 (AEC-tr-4672) EFFECT OF THE PHASE STATE OF POLYETHYLENE DURING IRRADIATION ON THE NATURE OF THE NEWLY-FORMED LATTICE. A translation of "Vliyanie Fazovogo Sostoyaniya Polietilena pri Obluchenii na Kharakter Obrazuyushcheĭsya Setki." G. P. Ushakov, Yu. A. Gushcho, Yu. S. Lazurkin, and V. S. Kazakov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 21p.

The effect of the phase state of polyethylene irradiated in a reactor on the nature of the newly formed lattice was investigated. Keeping the average lattice density the same, its effect on the melting temperature and on the degree of crystallinity of the irradiated polymer yielded quite different results, depending on whether the lattice was formed by irradiating the polyethylene in crystalline or in amorphous state. If the polyethylene was irradiated in the crystalline state, the resulting lattice formed a highly organized chain arrangement in the crystalline unit. In addition to degrading the crystals and decreasing the degree of crystallinity such a lattice increased the strength of the remaining smaller crystals. Therefore the melting temperature of the polyethylene with such a lattice decreased only slightly and non-uniformly with the dose. The lattice formed by irradiating molten polyethylene lowered the melting temperature at a much faster rate as a function of the dose and suppressed crystallization completely at significantly lower dose levels than if the irradiation was performed in the crystalline state resulting in the formation of a rigid resin-like material. (auth)

1813 (AEC-tr-4709) ANISOTROPY OF HYPERFINE SPLITTING OF ELECTRONIC PARAMAGNETIC RESONANCE SPECTRA OF IRRADIATED ORIENTED POLYMERS. A translation of "Anizotropiya Sverkhtonkogo Rasshchepleniya v Spektrakh Elektronnogo Paramagnitnogo Rezonansa Obluchennykh Orientirovannykh Polimerov." A. G. Kiselev, M. A. Mokul'skii, and Yu. S. Lazurkin (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 21222.

1814 (AEC-tr-4854) RADIO-CHEMICAL REACTIONS IN NUCLEAR REACTORS. J. Pucheault, M. Lefort, and M. Haissinski. Translated by Gordon R. Love (Carnegie Inst. of Tech., Pittsburgh) from J. chim. phys., 49: 286-93(1952). 18p.

The formation of hydrogen peroxide from aqueous solutions of borates irradiated with alpha plus Li^7 rays resulting from the reaction of B^{10} with neutrons is accompanied by a partial destruction of the compounds due to the ambient radiation in the pile. A procedure is described which permits taking this effect into account and renders these results reproducible and coherent. Several facts were observed. In 0.8N H_2SO_4 solutions or alkaline solutions the quantity, x, of H_2O_2 formed is proportional to the time and the intensity of irradiation. The efficiency is less than that calculated for the formation of these compounds due to the action of alpha rays from radon. At intermediate pH, x is again proportional to time, but, for a given intensity, I, x approaches a limiting value given by the relationship $x = (kIt/1 + k'I)$. For relatively short times and relatively high intensities of radiation, the measured x is significantly higher than the value calculated from this equation. Interruption of the radiation even for a short time under certain conditions may lead to an enhanced formation of H_2O_2 relative to that obtained under the same duration of uninterrupted radiation. Addition of hydrogen peroxide to the solution before irradiation has no effect on the quantity of H_2O_2 formed. For a qualitative interpretation of these results it was assumed that, under the action of the radiation, H_2BO_3 and H_3BO_4 are formed and are meta-stable in acid solutions. In addition, it appeared that the kinetics of the formation of H_2O_2 are essentially controlled by the transformations which occur along the trajectory of the alpha and Li^7 particles. (auth)

1815 (CEA-tr-R-1407) COCRISTALLISATION DE SUBSTANCES RADIOACTIVES AVEC DIVERS PRECIPITES. (Cocrystallization of Radioactive Substances in Various Precipitates). V. I. Grebenshchikova (Grebenschikova). Translated into French from Khim. Nauka i Prom., 4: 456-64(1959). 52p. (Includes original, 9p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 2472.

1816 (NP-tr-807) MODIFICATION OF FIBRES BY RADIATION-INDUCED GRAFT POLYMERISATION. Yasuo Shinohara. Translated by S. G. Brickley (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kobunshi Kagaku, 17: 197-201(1960). 21p.

When ordinary cellulose or nylon fibers, after being subjected to irradiation, are brought into contact with a vinyl monomer, or a solution of such, graft polymerization takes place readily and the additional presence of water or methanol when polymerization is brought about is effective. When a vinyl polymer having a high transition point is grafted on, the fiber generally becomes hard and, conversely, if the transition point is a low one, the fiber becomes softer. Strengths and degrees of water absorptiveness are also discussed. (auth)

1817 THE VARIATION BETWEEN +20°C AND −180°C OF THE ELECTRON PARAMAGNETIC RESONANCE SIGNAL OF GLYCINE IRRADIATED WITH γ RAYS. Andre Bottreau and Serge Nahon (Faculte des Sciences, Bordeaux). Compt. rend., 253: 844-6(July 31, 1961). (In French)

The temperature regions in which the "quintet" and "quartet" structures are observed for the signal of electron paramagnetic resonance given by a sample of polycrystalline glycine powder irradiated with γ rays are defined. (tr-auth)

1818 THE ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF ACETYLENE AND ITS DERIVATIVES IRRADIATED WITH γ-RAYS. D. N. Shigorin, V. I. Smirnova, G. S. Zhuravleva, E. P. Gracheva, and M. F. Shostakovskii (Karpov Physics-Chemistry Inst., SSSR). Doklady Akad. Nauk S.S.S.R., 140: 419-22(Sept. 11, 1961). (In Russian)

The electron paramagnetic resonance (EPR) spectra were obtained on acetylene, methyl acetylene, methyl deuteroacetylene, ethyl- and butylacetylene, and also phenyl- and methylphenyl-acetylene, irradiated at 77°K with 1×10^6 to 40×10^6 rads from a Co^{60} source. The yield of radicals was determined as a function of irradiation dose. The yield of radicals for methyl-, ethyl- and butylacetylene increases somewhat with increasing chain length for a given irradiation dose. The radical yield increases on increasing the irradiation dose from 1 to 40 million rads. It attains a maximum at 20 million rads, and then falls off. Irradiated methyl acetylene shows the presence of a propylene radical, $CH_2 - C = CH$. The other acetylene derivatives ($R - CH_2C \equiv CH$, where $R = C_2H_3$, C_3H_7 etc.) show radicals of the following type: $R - CH - C \equiv CH$, R and $CH_2 - C \equiv CH$. Irradiated acetylene forms polymeric compounds. (TTT)

1819 LABELLING OF ORGANIC COMPOUNDS BY U. V. PROMOTED EXCHANGE WITH TRITIUM GAS. F. Cacace, E. Ciranni, G. Ciranni, and G. Montefinale (Università, Rome). Energia nucleare (Milan), 8: 561-5 (Sept. 1961). (In English)

In order to accelerate the tritiation of organic compounds exposed to tritium gas, according to the Wilzbach's method, a simple technique, based on the ultraviolet exchange between the gaseous tritium and the organic substrate, was developed. The results obtained for the labelling of a few representative organic molecules and their mixtures are described. (auth)

1820 RADIATION CROSSLINKING OF VINYL CHLORIDE-VINYL STEARATE COPOLYMER. A. A. Miller (General Electric Co., Schenectady, N. Y.). J. Appl. Polymer Sci., 5: 388-96(July-Aug. 1961).

The crosslinking of internally plasticized polyvinyl chloride—stearate copolymer by irradiation with high-energy electrons was studied. Based on gel yields and swelling as a measure of relative crosslinking, the effect of added tetrafunctional monomers, and of carbon black and silica fillers are discussed. Crosslinking by dicumyl peroxide at 170°C even in the presence of a stabilizer, causes concurrent decomposition (dehydrochlorination) which is avoided in the radiation crosslinking process. The heat stability of the copolymer is not impaired by radiation crosslinking under the proper conditions. Results of tensile measurements at 25 and 150°C are given for the radiation crosslinked copolymer with and without filler reinforcement. (auth)

1821 PEROXIDE- AND RADIATION-CURED COMPOUNDS FILLED WITH REINFORCING FINE-PARTICLE SILICA. J. W. Sellers, M. P. Wagner, B. J. DeWitt, C. C. Stueber, and J. H. Bachmann (Pittsburgh Plate Glass Co., Barberton, Ohio). J. Appl. Polymer Sci., 5: 397-400(July-Aug. 1961).

There are indications that the chemical reaction involved in bound rubber formation proceeds via a free-radical mechanism for compounds filled with reinforcing hydrated fine-particle silica, as well as in the case of carbon black as filler. The high potential of silica as a rubber reinforcer is indicated by its bound rubber formation. This potential was realized by the extent of filler-polymer interaction developed in silica-filled vulcanizates cured by peroxide and by high-energy radiation, respectively. Both these relatively simple curing systems are postulated to effect crosslink formation via a free-radical mechanism. The value, after cure, of the ratio of the crosslink density of the filled compound to the crosslink density of the respective unfilled compound, η/η_0, was taken to be a logical measure of the ability to reinforce. In natural rubber compounds filled with silica (30 vol), the values of η/η_0 obtained were 1.6—1.9 for peroxide-cured material, and 3.6 for radiation-cured material. Comparisons are made with similarly cured HAF black-filled stocks. Sulfur-cured natural rubber stocks filled with HAF black (30 vol) generally exhibit η/η_0 values in the range of 1.5 to 2.0. Comparative effects of antioxidants are described. (auth)

1822 STUDIES ON THE γ-IRRADIATION OF NATURAL RUBBER LATEX. THE EFFECTS OF ORGANIC HALOGEN COMPOUNDS ON CROSSLINKING BY γ-IRRADIATION. Yuji Minoura and Mamoru Asao (Osaka City Univ.). J. Appl. Polymer Sci., 5: 401-7(July-Aug. 1961).

As the accelerating effect of water in the crosslinking reaction of rubber in natural latex by γ irradiation was assumed to stem from the decomposition of water into radicals by γ irradiation, more effective reagents were sought among the organic halides which have greater G values for radical formation by γ irradiation and, simultaneously, an affinity for rubber greater than that of water. 1,2-Dichloroethane, chloroform, carbon tetrachloride, and benzene (for comparison) were tested, and these compounds, except for benzene, were found to accelerate the reaction in proportion to their G values for radical formation. Benzene was found to have no effect, in concentrations between 1 and 5 phr. The optimum dosage was decreased to 2.1×10^6, 1.0×10^6, and 7.6×10^5 r by the addition of 1, 3, and 5 phr of carbon tetrachloride, respectively, and was assumed to have decreased to 1.17×10^7, 9.0×10^6, and 7.6×10^6 r with 1, 3, and 5 phr of 1,2-dichloroethane, and to 8.6×10^6, 6.2×10^6, and 5.2×10^6 r with 1, 3, and 5 phr of chloroform, respectively. The physical properties of the films obtained at the optimum dosages under these accelerating conditions were equal to those of the latex irradiated up to the optimum dosage with no addition of halide. No side reactions occurred during the halide-accelerated crosslinking that were sufficiently extensive to influence the infrared spectra. (auth)

1823 ELECTRON SPIN RESONANCE STUDIES OF POLYVINYL CHLORIDE IRRADIATED IN HN$_3$ GAS. Hisashi Ueda, Zen'ichiro Kuri, and Shoji Shida (Tokyo Labs., Japanese Assn. for Radiation Research on Polymers). J. Appl. Polymer Sci., 5: 478-81(July-Aug. 1961).

The electron spin resonance of polyvinyl chloride (PVC) irradiated in NH$_3$ was studied. The radicals produced on irradiation in NH$_3$ do not differ greatly from those obtained on irradiation in vacuum, but the reactivity of the former to SO$_2$ to form RSO$_2$ radicals is far higher than that of those obtained in vacuum. The radicals produced by irradiation at −78°C and in vacuum was also studied. The spectra of these radicals were different from those of the radicals produced at 20°C and in vacuum. The reactivity of the radicals produced in PVC is interpreted on the basis of the length of double bonds conjugating with the radical π-electron. (auth)

1824 IMPROVED DYEABILITY OF POLYACRYLONITRILE FIBERS BY RADIATION GRAFTING WITH VINYLPYRROLIDONE. Charles A. Levine and Teddy G. Traylor (Dow Chemical Co., Pittsburg, Calif.). J. Appl. Polymer Sci., 5: 606-11(Sept.-Oct. 1961).

Two processes are described. In one, doses of 10-60 krad are given to the polymer-aqueous monomer system at dose rates of 3-27 krad/min. In the other process, 0.2−3.0 Mrad is given the system at 0.5−90 Mrad/sec, followed by a heat treatment to elongate the graft side chain. Oxygen inhibits the grafting and various inorganic salts such as sulfates and phosphates enhance the grafting. (auth)

1825 PARAMAGNETIC DEFECTS IN IRRADIATED NH$_4$ClO$_4$. Terry Cole (Ford Motor Co., Dearborn, Mich.). J. Chem. Phys., 35: 1169-73(Oct. 1961).

Analysis of the electron magnetic resonance of x-ray damaged crystals of NH$_4$ClO$_4$ shows that the long-lived defects are NH$_3^+$ ions. Isotropic hyperfine splittings are found to be 54.6 mc for nitrogen and 72.5 mc for hydrogen. These radicals appear to be planar and execute restricted rotation at room temperature. A second transient defect is identified as ClO$_3$. (auth)

1826 RADIATION CHEMISTRY OF ORGANIC HALOGEN COMPOUNDS. PART I. THE ACTION OF γ-RADIATION ON CHLORINATED ETHYLENES. W. Miller, W. H. Stafford, W. H. Taylor, D. Leaver, and A. H. McQuillan (Univ. of Edinburgh). J. Chem. Soc., 4485-9 (Oct. 1961).

Both stereoisomers of 1,2-dichloroethylene polymerize under the influence of γ radiation but only the trans-isomer gives a solid polymer. Trichloroethylene produces lower yields of oligomers, chloroacetylenes, and a solid decachlorohexane. Tetrachloroethylene gives the lowest yield of oligomer and also hexachloroethane, hexachlorobuta-1,3-diene, and hexachloro-4-dichloromethylenecyclopentene. (auth)

1827 INFLUENCE OF CARBON DIOXIDE ON THE YIELDS OF HYDROGEN ON IRRADIATION OF AQUEOUS SOLUTIONS OF ORGANIC COMPOUNDS WITH ^{60}Co γ-RAYS. J. T. Allan, N. Getoff, H. P. Lehmann, K. E. Nixon, G. Scholes and M. Simic (King's Coll., Newcastle-upon-Tyne, Eng.). J. Inorg. & Nuclear Chem., 19: 204-7(Oct. 1961). (In English)

In order to test whether adventitious quantities of CO$_2$ were responsible for discrepancies in hydrogen yields, modified experimental technique was used to eliminate, to a greater or lesser extent, any CO$_2$ from the solutions prior to irradiation. With this technique, higher gas yields were consistently obtained. In some experiments carried out with aqueous solutions of various organic substances saturated with CO$_2$, it was found that CO$_2$ substantially depressed the yield of hydrogen on irradiation. Lowering the pH reduced the effect of added CO$_2$ until, the 0.8 N sulfuric acid solutions, this was essentially zero. It was concluded that, in addition to reaction with polarons, CO$_2$ can also react with the second hydrogen atom species produced in the primary radiolysis (G = 0.6 in neutral solutions) and which is possibly a hydrogen atom or an excited water molecule. (P.C.H.)

1828 HYDROLYTIC AND PHOTOLYTIC REACTIONS IN THE SYSTEM: WATER−HYDROCHLORIC ACID−URANYL CHLORIDE−BUTYL PHOSPHORIC ESTERS. A. S. Kertes and M. Halpern (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 19: 359-62(Oct. 1961). (In English)

The phenomenon of the homogeneous organic layer, initially uranium(VI), turning from yellow to a greenish tinge, characteristic of uranium(IV), while forming the gel precipitate in the extraction of uranium, is described. The homogeneous equilibrium organic layers, previously separated from the opposing equilibrium aqueous phases, and containing both hydrochloric acid and uranyl chloride in various concentrations, could not be kept unchanged after a period of 8 to 10 days under normal laboratory conditions of light and temperature. After this period a solid began to separate out. Once the transformation starts it proceeds quite rapidly and is usually complete in a few days. The green gel is completely soluble in chloroform and partially soluble in toluene. It is also soluble in hot, concentrated nitric acid. The mechanism of the phenomenon is discussed. (P.C.H.)

1829 ELECTRIC EQUIPMENT FOR RADIOCHEMICAL IRRADIATION SOURCES. [PART] II. Josef Šimorda (Inst. of Rubber and Plastic Tech., Gottwaldov, Czechoslovakia). Jaderná energie, 7: 301-9(1961). (In Czech.)

A discussion of electron accelerators, x-ray apparatus, ultraviolet radiation sources, and electric discharge apparatus, used as sources of radiochemical radiation sources, is presented. Equipment design and properties are described, and technical and economic problems in irradiation by accelerated electrons are stressed. (L.N.N.)

1830 RESEARCH IN RADIATION CHEMISTRY AND HOT ATOM CHEMISTRY. Jiří Teply and Vladimír Kačena (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 348-51(1961). (In Czech.)

A survey is given of the work carried out in the field of radiation chemistry in Czechoslovakia. The work consisted of studies of the radiolysis of chloroform, iron salts, tetrachlormethane, cystine, nitrates, organic moderators and cooling media, and extraction agents. Corresponding evaluation methods such as gas chromatography are described. A survey of the radiation sources of the Institute is given. In the field of hot atom chemistry, the studies are confined to work on arsenic-76, alkyliodides, Szilard Chalmers retention, and reactions of sulfur-32, bromine-80, and bromine-82. (N.W.R.)

1831 ELECTRON SPIN RESONANCE OF γ-IRRADIATED, SUBSTITUTED TOLUENES. N. K. Bridge (Argonne National Lab., Ill.). Nature, 185: 30-1(Jan. 2, 1960).

The electron spin resonance of gamma-irradiated substituted toluenes is reported. The results were obtained during an attempt to study the energy transfer efficiency from low-temperature, rigid glass solvent to dissolved solute molecules on gamma irradiation. The results show that there is a correlation between the electron spin resonance line spread in gauss and the radicals detected by Porter et al. by ultra-violet spectroscopy. (N.W.R.)

1832 PRODUCTS OF THE γ-RADIOLYSIS OF AQUEOUS CYSTINE SOLUTIONS. D. W. Grant, S. N. Mason, and M. A. Link (Defense Research Chemical Labs., Ottawa). Nature, 192: 352-3(Oct. 28, 1961).

Products were identified in Co^{60} gamma irradiated unbuffered and acidified cystine solutions at relatively low doses. Oxygenation and deoxygenation of solutions was effected by bubbling oxygen and nitrogen through the solutions during irradiation. The chromatographic data and spot colors suggest that cystine disulfoxide, cysteic acid, cysteine sulfinic acid, alanine, and cysteine are radiolytic products. Reactions are given which explain the mechanism of each yield. (P.C.H.)

1833 NUCLEAR FISSION. G. N. Walton (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Quart. Revs. (London), 15: 71-98(1961).

Some of the chemical problems associated with the fission process and its initial products are described. The part that chemistry has played in the development of nuclear fission is also discussed. Fission is also discussed in terms of its discovery, the processes involved, kinetic energy, range of fragments, effects on the medium in which it occurs, and the chemical state of fission products. (N.W.R.)

1834 THE EFFECT OF POLONIUM ALPHA RAYS ON THE PHYSICAL PROPERTIES OF POLYETHYLENE AND OF POLYMETHYL METHACRYLATE. Ruth F. Itzhaki and Peter Alexander (Royal Cancer Hospital, London). Radiation Research, 15: 553-60(Nov. 1961).

Alpha particles crosslink films of polyethylene more effectively than do sparsely ionizing radiations, but even in the absence of oxygen α-rays produce simultaneously some main-chain scission. Polymethyl methacrylate films were degraded by α-particles, but the energy needed to produce a main-chain break (detected by viscosity measurements) was 263 ev as opposed to approximately 60 ev with the 2-Mev electrons. The addition of naphthalene and 8-hydroxyquinoline to the polymethyl methacrylate did not lead to protection against α-radiation, although these substances protect against sparsely ionizing radiations. The reasons the relative effectiveness of α-rays is greater than that of sparsely ionizing radiations for crosslinking and less for degradation are discussed. It is postulated that the molecules in polymethyl methacrylate are in a randomly coiled configuration and that they are broken at several points where a segment is traversed by an α-particle, the small molecules produced by the closely spaced breaks being without effect on the viscosity molecular weight. In polyethylene films the molecules are oriented parallel to the sheet, and the path length of an α-particle through them is such that few ionizations are wasted. The production of main-chain scission is attributed to dissociation of a C–C bond. Recombination by a Franck-Rabinowitch cage effect is postulated to occur with sparsely ionizing but not with densely ionizing radiations. (auth)

1835 RADIATION CHEMISTRY OF n-HEXADECENE-1. E. Collinson, F. S. Dainton, and D. C. Walker (The University, Leeds, Eng.). Trans. Faraday Soc., 57: 1732-49(Oct. 1961).

When n-hexadecene-1 (HD) is irradiated with Co^{60} γ rays, hydrogen, C_1-C_8 hydrocarbons, and polymer are formed. G for hydrocarbons in the range C_9 to C_{31} inclusive is <0.04. The polymer contains vinyl and trans vinylene groups. The effects of temperature in the range −196 to 20°C, of added $FeCl_3$, benzoquinone, and DPPH on the G values of these products are determined. The rates of polymerization of reduction of ferric chloride and vinyl group formation are temperature dependent in the solid phase and show a sharp discontinuity at the m.p. (4°C). whereas $G(H_2)$ and G(trans vinylene) are equal and only slightly affected by temperature and melting. These and other observations are explained in terms of a mechanism in which ions are more important than radicals. cationic polymerization being propagated within the laminae in which the vinyl groups of solid HD are concentrated. and hydrogen being eliminated from long chain cations with consequential formation of trans vinylene groups. Two types of cations are initiators: one having the positive charge located in the vinyl plane can initiate at all temperatures. while the other has the positive charge on the hydrocarbon chain and can only initiate when the molecular motions enable the charged part of the ions to approach the vinyl groups. i.e., at temperatures ≥ -25°C (λ-point of HD). (auth)

1836 ISOTOPE EXCHANGE METHOD FOR DETERMINING SATURATED VAPOR PRESSURE AND DIFFUSION COEFFICIENTS. III. METHOD OF TREATMENT OF EXPERIMENTAL DATA. V. I. Lozgachev (All-Union Scientific-Research Inst. of Mineral Resources). Zhur. Fiz. Khim., 35: 2199-2209(Oct. 1961). (In Russian)

A method was devised for determining the constants in the solution of the diffusion equations in isotopic exchange through the gaseous phase from gamma and beta ray measurements. Equations were obtained which permit the rate of evaporation n_0, the diffusion coefficient D, and the exchange layer thickness δ to be determined from a single experimental plot of data from the start of the process to the steady state, inclusively. A formula for calculating the condensation coefficient and a method for its experimental determination are given. (auth)

1837 KINETIC BEHAVIOR OF THE RADIOLYSIS PRODUCTS OF WATER. Christiane Ferradini (Institut du Radium, Paris). p.171-205 of "Advances in Inorganic Chemistry and Radiochemistry. Volume 3." New York, Academic Press Inc., 1961.

A study was made of energy absorption by matter and the chemical phenomena occurring in irradiated aqueous solutions. Topics covered include the primary action of ionizing radiations, nature of chemical changes in irradiated aqueous solutions, mechanism of the radiolysis of water, rates of formation of radical and molecular products, nature of the chemical action of radical and molecular products, rates of chemical reactions of radical products, rates of reactions of the OH radical, rates of reactions of H atoms, and heterogeneous kinetics in radiation chemistry. (M.C.G.)

1838 PROCESS FOR TREATING LOWER ALKANES BY IRRADIATION. Simon Lyon Ruskin. British Patent 881,491. Nov. 1, 1961.

A process is given for converting lower alkanes to liquid hydrocarbons. The process comprises exposing the alkanes to from 25 to 100 Mrad gamma radiation per g alkane at a pressure of 100 to 500 psi and in the presence of an inorganic catalyst. Several examples of the process using a cobalt bomb are given. (D.L.C.)

1839 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF OXYGENATED ORGANIC COMPOUNDS. (to British Petroleum Co. Ltd.). British Patent 882,863. Nov. 22, 1961.

An improved process is outlined for the production of C_2 and C_3 oxygenated organic compounds by the oxidation of propylene. The process comprises reacting propylene at 250 to 450°C with oxygen or air in the presence of high-energy ionizing radiation. The dose rate preferably is 10^6 to 10^9 rad/hr. (D.L.C.)

Raw Materials and Feed Materials

Refer also to abstract 2146

1840 (BM-RI-5875) FLOTATION OF BERTRANDITE AND PHENACITE FROM MOUNT WHEELER, NEV., BERYLLIUM ORE. Richard Havens, W. I. Nissen, and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). Apr. 1961. 17p.

A flotation procedure was devised for beneficiating beryllium ores that contain the beryllium minerals bertrandite and phenacite in a complex association with calcite, fluorspar, mica, quartz, and other accessory minerals. Samples used in most of the research ranged from 0.49 to 0.73% BeO. Beryllium mineralization varied from two-thirds bertrandite to all phenacite. An unusually high grade sample containing 5% BeO as phenacite was floated on a batch basis to prepare concentrate for utilization studies. The beryllium minerals were floated from undeslimed pulps at natural pH using sodium fluoride and sodium hexametaphosphate (HMP), as modifiers, and a fatty acid-fuel oil combination as the collector. Key factors were the use of a minimum of about 4 pounds of sodium fluoride and 2 to 4 pounds of HMP per ton of ore. Efficacy of the HMP was related to the grind, mineralogical composition, corollary reagents, and type and time of conditioning. Addition of the fluoride, HMP, and collector in that order, followed by appropriate conditioning after each addition, was essential for satisfactory flotation. A typical result obtained by bench-scale batch tests in a 500-gram cell on a bertrandite-phenacite sample of 0.49% BeO was 82% recovery in a concentrate of 14% BeO. Flotation of phenacite ore containing 5% BeO in a 10-kg cell resulted in an 85% recovery in a concentrate of 34% BeO. (auth)

1841 (PAN-231/IV) INFLUANCE DE CERTAINS FACTEURS SUR L'EFFICACITE D'EXTRACTION GAZEUSE DE L'URANIUM DE SES MATIERES PREMIERES. (Influence of Certain Factors on the Efficiency of Gaseous Extraction of Uranium from its Raw Materials).
J. Zienkiewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). May 1961. 15p.

The quantity, flow rate, and concentration of the reacting gas, as well as the temperature and the carbon content of the charge, influence the efficiency of extraction of U by Cl_2. On replacing these variables by known values, it is shown that a high extraction efficiency may be obtained. (tr-auth)

1842 (AEC-tr-4717) INVESTIGATION OF THE ROLE OF OXIDATION-REDUCTION PROCESSES IN THE DISSOLUTION OF URANIUM OXIDES IN ACID MEDIA. A translation of "Issledovanie Roli Okislitel'no-Vosstanovitel'nykh Protesessov pri Rastvorenii Okislov Urana v Kislykh Sredakh." G. M. Nesmeyanova and G. M. Alkhazashvili (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 14p.

Results are given of an investigation of the process of oxidation and dissolution of the uranic-uranous oxide in acid media and the effect of compounds of divalent iron on this process. A comparison is given of the oxidizing ability of various oxidizers relative to uranium. It is shown that the oxidation of tetravalent uranium is not determined by the normal oxidation-reduction potential uniquely. The results obtained indicate that the causes of the incomplete extraction of uranium with a mixture of nitric and sulfuric acids at low concentrations, in cases when the solutions contain large numbers of iron ions, are connected with the processes of complex formation between the ions Fe^{2+}, SO_4^{2-}, and NO_3^-. (auth)

1843 (NP-tr-806) A METHOD OF OBTAINING URANIUM CONCENTRATE FROM URANIUM-BEARING MATERIAL. P. O. Stelling and J. E. K. Svenke. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Swedish Patent No. 148719. [nd]. 11p. (Handwritten MS. copy).

A method for economically obtaining uranium from raw material which is relatively poor in uranium is described. The uranium is converted into a halogen compound which is easily volatilized. This halogen and other metal-halogen compounds simultaneously formed are separated from the raw material by volatilization and then condensed to a solid concentrate. It was found that, the higher the temperature, the more selective is this conversion to halogen compounds as regards uranium. Halogen salts such as sodium chloride or fluorspar were used instead of the halogens themselves. If the raw material does not contain a reducing agent, a combustible reducing agent such as carbon is added. (M.C.G.)

1844 CHLORINATION OF MONAZITE. O. M. Hilal and F. A. El Gohary (National Research Centre, Dokki, Cairo). Ind. Eng. Chem., 53: 997-8(Dec. 1961).

A laboratory scale chlorination of Egyptian monazite sand concentrate was carried out at 900°C in a horizontal tube furnace, and the variables affecting the condensation and purity of the thorium chloride produced were studied. In 30 minutes, 97.8% of the monazite content was attacked. The thorium chloride condensed in the first collector at the first adjustment (850 to 375°C) was contaminated with 3.7% of the chlorides of uranium, iron, and phosphorus. By using the second adjustment (850 to 475°C) it was possible to get thorium chloride of 99.2% purity free from uranium chloride. The purity of the rare earth chlorides obtained decreased by decreasing the purity of monazite concentrate as the chlorides of calcium and magnesium are nonvolatile at the chlorinating temperature. On the other hand the degree of purity of the thorium chloride collected was very slightly affected. (P.C.H.)

1845 RECOVERY OF URANIUM FROM CALCIUM NITRATE BY CONTINUOUS ION EXCHANGE. Irwin R. Higgins (Chemical Separations Corp., Oak Ridge, Tenn.). Ind. Eng. Chem., 53: 999-1002(Dec. 1961).

A study was made to determine what yields and production rates might be expected when recovering uranium from concentrated nitrate salts as a function of the significant variables. The practical production rate for recovery of uranium from nitrate salt solutions was found to be slower than from chloride solutions by a factor of about 8, even after giving the nitrate system the advantage of higher temperature. Increasing the operating temperature from 52 to 64°C increased the production rate about 25%. Increasing the $Ca(NO_3)_2$ concentration from 6 to 7.6 $\underline{N}$ increased the production rate about 25% also. Using the 20 to 50 mesh resin instead of 16 to 20 mesh increased the production rate about 10%. The advantages of both the nitrate and chloride systems are discussed. (P.C.H.)

1846 ACTIVATING URANIUM DIOXIDE. R. J. Bard, J. P. Bertino, and D. L. Bunker (Los Alamos Scientific Lab., N. Mex.). Ind. Eng. Chem., 53: 1003-6(Dec. 1961).

Results of a study of the mechanism of UO_2 activation by successive oxidation and reduction are presented. Surface area, pore size, and x-ray measurements showed that activation of aggregates of microcrystalline UO_2 resulted from separation, but not reduction in size, of primary crystallites. Hydrofluorination of UO_2 to UF_4 was found to be sensitive to changes in porosity of the UO_2 during the reaction. Repeated successive oxidation and reduction of the UO_2 produced first an increase in surface area at constant crystallite size, because of separation of adhering microcrystals, and then a decrease in loose bulk density with both crystallite size and surface area constant, because of further separation of the detached microcrystals. These physical changes resulted in greatly increased chemical reactivity toward HF gas and oxygen. The results define the nature of poor reactivity which may occur in pure microcrystalline UO_2 and explain the increase in reactivity by successive oxidation and reduction. (P.C.H.)

1847 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF PLUTONIUM. David Watson Clelland, Walter Wilkinson Marshall, and Glyn Rhys Evans (to United Kingdom Atomic Energy Authority). British Patent 882,950. Nov. 22, 1961.

A process and an apparatus are described for carrying out the step of plutonium oxalate precipitation from plutonium nitrate solutions in a continuous and economical manner without criticality risks. In this process, plutonium nitrate and oxalic acid solutions are fed to a stirred vessel at 80°C to effect precipitation, and the resulting slurry is passed by gravity flow to a cooler at 25°C and thence to a column having an upward flow feed of a washing mixture of oxalic and nitric acids. The precipitate settles to the bottom of the column, from which it may be continuously withdrawn through a valve. The apparatus is of eversafe geometry. (D.L.C.)

1848 HIGH TEMPERATURE REDUCTION OF URANIUM HEXAFLUORIDE TO METAL. (to U. S. Atomic Energy Commission). British Patent 883,160. Nov. 22, 1961.

A single-step, continuous process for the production of U metal from UF_6 is outlined in which Na is used as the reducing agent. The process comprises reacting UF_6 vapor and fluid Na in a reaction chamber at a temperature above the melting point of U, and withdrawing the resulting liquid U and liquid NaF from the chamber. An apparatus for carrying out the process is described. (D.L.C.)

Separation Processes

Refer also to abstracts 1878, 1987, and 1988

1849 (AAEC/E-62) PULSE COLUMNS IN NUCLEAR FUEL PROCESSING. PART II. FLOODING CHARACTERISTICS. PART III. CORRELATION OF FLOODING CHARACTERISTICS IN TERMS OF PHYSICAL PROPERTIES OF THE PHASES. M. G. Baillie (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1961. 44p.

An investigation was made of the flooding characteristics of a 1 in. diameter pulse column used to extract uranium from relatively viscous, high density feed solutions of aluminum and uranium nitrates. For the particular solution used the density was 1.240 g/cm^3 and the viscosity was 3.31 centipoises. The optimum pulse volume velocity (product of pulse amplitude and frequency) to give maximum throughput without flooding for this solution was found to lie between 970 and 1150 imp. gal/(hr)(ft^2). A second investigation described the effect of variations in the physical properties of the phases of flooding behavior at optimum pulse volume velocity. A correlation as a power function was determined over a range of conditions in which the aqueous phase density varied from 1.13 to 1.37 g/cm^3, the organic phase density from 0.773 to 0.887 g/cm^3, the aqueous phase viscosity from 1.9 to 10.6 centipoises, the organic phase viscosity from 1.1 to 5.6 centipoises, and the interfacial tension between the two phases from 8.9 to 15.8 dynes/cm. The correlation, determined at a continuous phase flow rate of 120 ml/min, can be used in the range 80 to 180 ml/min. (auth)

1850 (AAEC/E-68) THE EXTRACTION OF BERYLLIUM BY TRIISOOCTYLAMINE IN THE PRESENCE OF OXALATE ION. H. J. de Bruin and R. B. Temple (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1961. 17p.

Beryllium ions can be extracted into organic solvents by tertiary amines, in the presence of compounds which give rise to anionic complexes. The nature of the extracted species is investigated for the system beryllium/oxalate/triisooctylamine; it appears to be $Be(C_2O_4)_2[NH(i-C_8H_{15})_3]_2$. The beryllium/oxalate/water system is examined by the method of pH titration in the absence of the organic phase. Under the conditions chosen, the dissociation constants for oxalic acid are found to be $K_1 = 4.64 \times 10^{-2}$ and $K_2 = 1.20 \times 10^{-4}$, and the stability constants for the beryllium oxalate complexes $\beta_1 = 6.32 \times 10^3$ and $\beta_2 = 3.91 \times 10^5$. (auth)

1851 (AAEC/E-77) THE EXTRACTION OF BERYLLIUM BY TRIISOOCTYLAMINE. THE EFFECT OF THE ANIONIC COMPLEXING AGENT. H. J. de Bruin, D. Kairaitis, and R. B. Temple (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Sept. 1961. 16p.

The extraction of beryllium by triisooctylamine is measured over the pH range from 1 to 10, in the presence of malonic, maleic, succinic, phthalic, and salicylic acids. Values are obtained for the stability constants of the various metal-acid complexes by potentiometric titration. The degree of extraction is dependent on the abundance of the anionic complex present in the aqueous phase and this is in turn dependent on the strength of the corresponding acid and the stability of the complex. (auth)

1852 (CEA-1980) ETUDE CONCERNANT LA REALISATION D'UN ENSEMBLE DE CELLULES DESTINEES A DES TRAITEMENTS DE COMBUSTIBLES IRRADIES A L'ECHELLE SEMI-INDUSTRIELLE. (The Development of a Cell-Assembly for the Treatment of Irradiated Fuels on a Semi-Industrial Scale). P. Faugeras. J. Couture, and G. Lefort (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 32p.

The main studies and experiments involved in the development of a cell-assembly for the treatment of irradiated fuels on a semi-industrial scale are described. It must be possible to modify or transform each of these cells without interrupting the rest of the pilot. A full-scale prototype cell (3 × 4 × 6 m) was built with an α-protection independent of the γ-protection. It features all the main characteristics: tightness to γ losses, dense glass lighting, and ventilation. This cell has made possible trials on transfer, remote-controls and teledismantling, as well as the development of new methods of rapidly connecting hydraulic circuits. The final form is given of the cells selected for the pilot. (auth)

1853 (HW-67400) PUREX—TRANSFER MEASUREMENT REVIEW. W. H. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1960. Contract AT(45-1)-1350. 12p.

Purex transfer measurement improvement since July 1959 is reviewed. Measurement methods in use for each accountability measurement point are recorded and their precision estimated. Each measurement was evaluated for adequacy of methods and quality with which the measurement is made. (M.C.G.)

1854 (IDO-14553) CHEMICAL PROCESSING TECHNOLOGY QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1960. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 15, 1961. Contract AT(10-1)-205. 76p.

ICPP Operations. Changes made in processing equipment are described, and the use of continuous steam stripping to free waste solvent of Pu is described. Aqueous Processing Studies. Studies were made of methods for separating Zr from dissolver solutions of U–Zr alloys. Recovery of U from BeO_2-UO_2 ceramic fuels by grinding-leaching technique using boiling HNO_3 reached 75 to 80%. Waste Calcination. Test results of feed spray nozzles for use in the Demonstrational Waste Calcining Facility are given. Studies were made on the calcination of aluminum nitrate and zirconium fluoride waste solutions. Waste Treatment. Removal of Cs and Sr from wastes by adsorption was investigated. The conditions for optimum separation of Fe, Ni, and Cr by Hg cathode electrolysis from waste solutions resulting from processing of stainless steel reactor fuels were determined. Electrolytic Dissolution Systems. The electrolytic dissolution of type 304 stainless steel was studied in the transpassive region as a function of electrode potential and HNO_3 concentration. An analog simulation study of an electrolytic dissolver is described. A niobium cathode in an electrolytic dissolver dissolving stainless steel in boiling HNO_3 did not absorb H_2. The corrosion resistance of several container materials to 1 M HNO_3 solution containing stainless steel was measured. Electrolytic disintegration of Zircaloy-2 in HNO_3 was studied. ARCO Process. The ARCO process was adapted to dissolution of UO_2 by addition of Cu as a catalyst to the $PbCl_2-Cl_2$ system. Dissolution rates were measured for Nb in molten $PbCl_2$. Equipment Development. Equipment for air pulsing of extraction columns and for preventing criticality of enriched U solutions are described. (D.L.C.)

1855 (IDO-14560) CHEMICAL PROCESSING TECHNOLOGY QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1961. J. R. Bower, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205. 93p.

Studies are reported on aqueous zirconium processing, dissolution of $BeO-UO_2$ ceramic fuel, the aqueous stainless steel process, the behavior of dibutyl phosphates, use of boron (boric acid) solution to assure critical safety, fluidized bed calcination, conversion of amorphous alumina to alpha alumina, the Demonstrational Waste Calcining Facility, removal of long-lived radioisotopes from waste solutions, separation of iron, nickel, and chromium from stainless steel waste solutions, electrolytic dissolution, effects of stray currents, electrolytic disintegration of Zircaloy-2, corrosion evaluation of materials of construction, the ARCO process, a direct air pulsed extraction column, and large vessel criticality control. (M.C.G.)

1856 (K-1477) REMOVING MAJOR CONTAMINANTS FROM NITROGEN GENERATOR GAS. C. F. Hale and Karl E. Rapp (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 23, 1961. Contract W-7405-Eng-26. 16p.

This investigation was performed to aid in evaluating the feasibility of substituting a bed of Linde Molecular Sieves for the multiple system of chemical purification stages normally employed in commercial nitrogen generator units. Type 5A Sieves had a breakthrough capacity for dry carbon dioxide equivalent to 10% of the weight of the Sieves compared to a capacity of about 90% determined for type 4A Sieves. The ability to adsorb carbon dioxide completely from a simulated dry gas feed was retained at the same level of efficiency by type 5A Sieves following a thorough regeneration at 318°C. The capacity for carbon dioxide was decreased slightly by the coadsorption of water vapor from a simulated wet gas feed. Repeated regeneration by means of a concurrent purge of dry air at 200°C, while sufficiently rigorous to desorb the carbon dioxide, would allow adsorbed water to accumulate to a level of about 6% of the weight of the Sieves. This much residual water will reduce the Sieves capacity for the less strongly adsorbed carbon dioxide to about one-third of the dry capacity. A more efficient regeneration at 200°C would be obtained by use of a countercurrent dry air purge. Maintenance of the purification efficiency at maximum level can be achieved by employing a 200°C regeneration which provides in addition that any part of the Sieves bed contacted by water vapor be heated to 315°C during the regeneration. (auth)

1857 (MCW-1466) URANIUM RECOVERY FROM SCRAP URANIUM TETRAFLUORIDE BY WET REVERSION WITH SODIUM HYDROXIDE. E. P. Grattan and W. T. Trask (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Nov. 15, 1961. Contract W-14-108-Eng-8. 11p.

A wet reversion process for the recovery of the uranium in scrap residues from the Weldon Spring Green Salt Plant was developed and is being operated in the chemical pilot plant. These residues, normally referred to as C-31 material, consist mainly of impure UF_4 and are currently being reverted at the rate of approximately 35 tons per month. The C-31 material is digested in a hot sodium hydroxide solution to revert the uranium tetrafluoride to an acid soluble uranium oxide. The product from this digestion is water-washed by decantation until the fluoride content is below 1.0% on a uranium basis and is then digested in hot nitric acid. Hydrated alumina is added to complex any remaining fluoride. The resulting uranyl nitrate solution is returned to the refinery process stream. The only difficulties encountered to date were of a purely mechanical nature. The product from the C-31 reversion process is entirely compatible with the refinery process. Corrosion problems to date were minor. (auth)

1858 (ORNL-TM-32) CHEMICAL TECHNOLOGY DIVISION UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, APRIL 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson

(Oak Ridge National Lab., Tenn.). Nov. 14, 1961. [Contract W-7405-eng-26]. 44p.

The density of the thoria product particles from Sol-Gel runs seemed to increase as the ratio N/Th decreases but this ratio along did not consistently correlate with sol properties. Seven capsules were prepared for the trial irradiation of thoria in the LITR. The three ion diffusion model gives reasonably accurate predictions of the uranyl sulfate loading rates on fluoride equilibrated anion resins. Back-mixing in the leacher rotary drum was found to be due to openings between the spiral flights and the inner cylinder at both ends. In the leaching of UO_2 it was found that 5.5 molar HNO_3 at a mole ratio of 5 was barely sufficient to completely dissolve the UO_2 in 4 hrs. Lowering the temperature to 10° below boiling reduces the leaching rate and the uranium loading. Runs dissolving 8% U–ZrH indicated that a minimum F/Zr ratio of 7.5 was required for total dissolution. Modified Zirflex runs without nitrate using both 8% U–ZrH and PWR-1 feed materials had dissolution rates comparable to those of the conventional reagent and an apparent increased tendency toward foaming. Experimental determinations of the temperature of spent fuel elements in simulated shipping casts have started. A waste calcination run using a close-coupled evaporator and calciner system operated and controlled very satisfactorily. (auth)

1859 (TID-3529(Rev.2)) REPROCESSING OF IRRADIATED FISSION REACTOR FUEL AND BREEDING MATERIAL. A Literature Search. James M. Jacobs, comp. (Division of Technical Information Extension, AEC). Oct. 1961. 87p.

A bibliography of selected unclassified reports on reprocessing of irradiated fission reactor fuel and breeding materials is presented. The listing contains 893 references arranged according to national origin, corporate author, and report number. (M.C.G.)

1860 (AEC-tr-4671) EXTRACTION OF ELECTROLYTES FROM NITRIC ACID SOLUTIONS BY NEUTRAL ORGANOPHOSPHORIC SOLVENTS. CALCULATION OF THE DISTRIBUTION CURVES. A translation of "Ekstraktsiya Elektrolitov Neitral'nymi Fosfororganicheskimi Rastvoritelyami iz Azotnokislykh Rastvorov. Raschet Krivykh Raspredeleniya." A. S. Solovkin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 25p.

In connection with the study of the quantitative laws of the extraction of electrolytes by neutral organophosphoric solvents from nitric acid solutions, equations have been derived which allow the calculation of the distribution coefficients without previous determination of the activity coefficients of the extracting materials. Good agreement of experimental and theoretical data was found in the literature and the present data. (auth)

1861 (AEC-tr-4874) ION EXCHANGE IN MIXED SOLVENTS. I. DISTRIBUTION OF URANIUM IN INORGANIC-ACID SOLUTIONS CONTAINING ALCOHOL, AND STRONGLY BASIC ANION EXCHANGER DOWEX-1. J. Korkisch, P. Antal, and F. Hecht. Translated by Lydia Venters (Argonne National Lab., Ill.) from J. Inorg. & Nuclear Chem., 14: 247-50(1960). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 24051.

1862 (AEC-tr-4875) ION EXCHANGE IN MIXED SOLVENTS. II. DISTRIBUTION OF THORIUM, ZIRCONIUM AND TITANIUM IN INORGANIC-ACID SOLUTIONS CONTAINING ALCOHOL, AND THE STRONGLY BASIC ANION EXCHANGER DOWEX-1. P. Antal, J. Korkisch, and F. Hecht. Translated by Lydia Venters (Argonne National Lab., Ill.) from J. Inorg. & Nuclear Chem., 14: 251-4(1960). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 24052.

1863 STUDY OF THE INDUSTRIAL ION-EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA, COPPER METHODS. V. IDEA OF INDUSTRIAL ION-EXCHANGE REFINING. Keijiro Nishigori. Denki Shikensho Ihô, 25: 429-32(June 1961). (In Japanese)

A method of industrial ion exchange refining of rare earth elements and that of recovery of EDTA and copper from ion-exchange effluent solution in the case of refining of lanthanum are discussed. The features of the methods are such that the refining of rare earth elements and recovery of EDTA and copper are continuously operated, and pure rare earth elements are obtained at high refining rates. (auth)

1864 STUDY OF THE INDUSTRIAL ION-EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA, COPPER METHODS. IV. PURIFYING OF IMPURE La_2O_3 BY USING THE ION-EXCHANGE EQUIPMENT. Keijiro Nishigori. Denki Shikensho Ihô, 25: 422-8(June 1961). (In Japanese)

By using an ion-exchange equipment, 4.4 kg of 92% La_2O_3 is purified and 3.4 kg of 99.9% La_2O_3 is obtained. Besides, from the solution effluent from ion exchange equipments, EDTA and copper are obtained with recovery rates of 90% and 98%. (auth)

1865 EXTRACTION STUDIES ON DIMETHYL-BENZYL-PHENYL-AMMONIUM CHLORIDE–HYDROCHLORIC ACID SYSTEM. Kaoru Ueno (Japan Atomic Energy Research Inst., Tokyo) and Cahu-ting Chang. J. At. Energy Soc. Japan, 3: 757-62(Oct. 1961). (In English)

Extraction behaviors of some sixty elements, from sodium to neptunium, in the dimethyl-benzyl-phenyl-ammonium chloride (DMBPAC)-hydrochloric acid system were studied. Distribution ratios were obtained for the hydrochloric acid concentrations of 0.5, 1, 2, 4, 6, 8, 10, and 12 N. Considerable regularities are found with respect to the corresponding congeners. The outcomes are compared with those of the hydrochloric acid-anion exchange resin and thiocyanate–triethyl benzyl ammonium chloride systems. Similarities among these systems are observed. However, for the present system the distribution ratios are in most cases smaller. Dependence of extractability upon ion concentrations was also investigated for iron. (auth)

1866 SYNERGISM IN THE SOLVENT EXTRACTION OF DI-, TRI-, AND TETRA-VALENT METAL IONS. I. SYNERGIC EFFECTS OF DIFFERENT PHOSPHATE ESTERS. T. V. Healy (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 19: 314-27(Oct. 1961). (In English)

Synergic effects noted previously only in the solvent extraction of uranyl ions are now shown to exist for other ions. Examples of this greatly enhanced extraction from aqueous solution are given for rare earths, actinides, and alkaline earths, the extracted species being $Ca(TTA)_2S_2$, $UO_2(TTA)_2S_1$, $UO_2(TTA)_2S_2$, $Pm(TTA)_3S_2$, $Tm(TTA)_3S_1$, $Tm(TTA)_3S_2$, $Am(TTA)_3S_2$, $Cm(TTA)_3S_2$, and $Th(TTA)_4S_1$ where S is a neutral organophosphorus ester varying from trioctyl phosphine oxide with its highly polar phosphorus oxygen bond to the very weakly basic triphenyl phosphate, and TTA refers to thenoyltrifluoroacetone. (auth)

1867 SYNERGISM IN THE SOLVENT EXTRACTION OF DI-, TRI- AND TETRAVALENT METAL IONS. II. SYN-

ERGIC EFFECTS IN SO-CALLED INERT DILUENTS. T. V. Healy (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 19: 328-39(Oct. 1961). (In English)

Greatly enhanced extractions (synergism) for di, tri, and tetravalent metals were reported for the system M^{n+}/HTTA/S/diluent where HTTA is thenolytrifluoracetone and S varies from the highly polar tri-octyl phosphine oxide to the weakly basic triphenyl phosphate. The extracted species $M(TTA)_nS_x$ is the same. whatever inert diluent is used, but the partition coefficients of the metal ion vary over several powers of ten, sometimes by a factor much greater than that obtained by the synergic effect itself. The effect, on the extraction, of so-called inert diluents such as cyclohexane, hexane, carbon tetrachloride, benzene, and chloroform was studied under various conditions. In all cases the distribution ratio decreases as the diluent is changed from cyclohexane in the above sequence, chloroform giving the lowest partition coefficient. This order is in the same sequence as the water solubility in the pure diluent and the diluent effect on metal extraction is probably connected through the diluent water content with the permanent or induced diluent dipole. (auth)

1868 RADIOCHEMICAL PROBLEMS OF NUCLEAR FUELS. Miroslav Bezděk (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 352-5(1961). (In Czech.)

A review is given of the radiochemical problems of nuclear fuels. The survey included a study of the dependency of the fission products in the range from one second to 32 years. The extraction of uranyl nitrate with diethyl ether, tributyl phosphate, cyclopentanone, methylcyclohexanone, and other ketones is studied; and some analytical studies are mentioned (the determination of uranyl nitrate in the presence of nitric acid, the determination of uranium in TBP, the determination of strontium, yttrium, cesium, etc.). Some methods of separation are described. (N.W.R.)

1869 STUDY OF INDUSTRIAL ION EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA COPPER METHOD. VI. MANUFACTURING OF INFLUENT SOLUTION AND PREPARATION OF EFFLUENT SOLUTION. Keijiro Nishigori. Denki Shikensho Ihô, 25: 611-7(Aug. 1961). (In Japanese)

The manufacturing of ion exchange influent solution and operation of effluent solution were studied in the case of ion exchange separation of rare earth elements by the EDTA copper method. Consequently, it was confirmed that in the case of industrial manufacturing of influent solution and recovery of EDTA, the dilution method is adequate in the former case, while in the latter case the continuous method is adequate in the case of copper complex salt, and the batch system is adequate in the case of rare earth complex salt. (auth)

1870 EXTRAKTIVE AUFARBEITUNG BESTRAHLTER KERNBRENNSTOFFE. (Extractive Recovery of Irradiated Nuclear Fuel). Siegfried Niese, Manfred Beer, Dieter Naumann, and Ralf Köpsel. Berlin, Akademie-Verlag, 1960. 230p. DM 44.

The present information on the extractive recovery of irradiated nuclear fuel was compiled, evaluated, and presented in a clear form. The theoretical bases of solvent extraction, the extractability of fission materials and fission products with the various extraction media, and the various procedures in processing plants are considered. The processes industrially used for the extraction of fissionable materials from ore solutions are also described. (J.S.R.)

1871 IMPROVEMENTS RELATING TO ION-EXCHANGE PROCESSES AND PLANTS. Thomas Victor Arden, John Bromley Davis, and Laurence Arthur Sargent (to Permutit Co. Ltd.). British Patent 879,834. Oct. 11, 1961.

An ion exchange apparatus is designed in which a pulp or suspension undergoes ion exchange by moving upwards through a bed of ion exchange beads. The bed is supported by the pulp, with the pulp flow rate being decreased at the pulp-bed interface so that the heavier, loaded pulp may move downwards into the pulp but not below the interface. This pulp flow rate decrease is effected by an open-ended cylinder whose upper end flares outward to meet the container wall and which is placed at the bottom of the apparatus. A collecting device is provided to remove settling resin from the bottom of the bed. The advantages of this apparatus are that no lower screen is needed and that lighter, unloaded resin is floated to the top of the bed where it can have a maximum stripping effect on the impoverished pulp. (D.L.C.)

1872 PLUTONIUM CONCENTRATION AND DECONTAMINATION METHOD. (to U. S. Atomic Energy Commission). British Patent 881,151. Nov. 1, 1961.

A process is outlined for concentrating and decontaminating Pu from an aqueous HNO_3 solution containing Pu, U, and fission products. The process comprises adjusting the solution to 0.15 to 0.5 $\underline{N}$ HNO_3, converting the Pu to Pu^{3+}, contacting the solution with a cation exchanger, and eluting the adsorbed Pu with a ≥ 4 $\underline{M}$ HNO_3 eluant containing a holding reductant. U elution may be carried out prior to Pu elution with a dilute H_2SO_4 solution containing a reductant. The reductant for conversion of Pu to Pu^{3+} is preferably hydroxylamine sulfate, while the holding reductant in the HNO_3 eluant should be sulfamic acid. The cation exchanger should be a sulfonated resin, preferably Dowex-50. (D.L.C.)

1873 IMPROVEMENTS IN OR RELATING TO LIQUID-LIQUID CONTACTING APPARATUS. Donald Hebden (to United Kingdom Atomic Energy Authority). British Patent 882,731. Nov. 22, 1961.

A mixer-settler apparatus is designed with means for effectively mixing liquid phases without the use of moving mechanical parts in contact with the liquids. The apparatus has a pair of fluid flow ducts communicating with each mixer compartment and means for withdrawing liquid from the compartment into one duct coincident with returning liquid to the compartment from the other duct of the pair. (D.L.C.)

1874 PROCESS FOR THE SEPARATION OF RADIOACTIVE IODINE 132 FROM FISSION TELLURIUM 132. (to Zentralinstitut für Kernphysik). British Patent 883,170. Nov. 22, 1961.

A process for separating I^{132} from a fission fraction containing Te is given which is rapid and which does not require special safety measures. In this process, the Te fraction, isolated from irradiated U, is converted into a solution of a tellurite and passed through a chromatographic column packed with a cationic material which is charged with reducing ions, e.g., Sn^{2+} ions. The cationic material combines with the Te^{132}, and the I^{132} may be removed from the column by an eluant such as distilled water. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 1358 and 2769

1875 (AAEC/E-69) STUDIES OF URANIUM–SODIUM SUSPENSIONS. PART I. CONSTRUCTION AND OPERATION OF EXPERIMENTAL LOOP. F. L. Bett, R. J. Hilditch, R. G. Mepham, and T. N. Kluss (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1961. 41p.

An experimental uranium–sodium suspension loop was operated for 4320 hr. The design, construction, commissioning, and operation of the loop to the point where a complete stable suspension was obtained is described. (auth)

1876 (ARF-1122-27) ISOTOPIC SOURCES OF SECONDARY RADIATION. Final Report. I. Filosofo (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 1, 1961. Contract AT(11-1)-657. 131p.

Recent work on isotopic x ray sources is reported. The research was directed toward optimization of high-level isotopic sources and evaluation of their use in typical scientific and technical applications. The resulting experimental data are used in obtaining an approximate mathematical formulation of x-ray output as a function of beta energy, target material, and source configuration. (J.R.D.)

1877 (BNL-5662) SOLID STATE PRECISION CURRENT SHUNT FOR EXPERIMENTAL MAGNETS. J. P. Palmer, W. A. Higinbotham, and W. Merkle (Brookhaven National Lab., Upton, N. Y.). July 10, 1961. Contract [AT(30-2)-Gen-16]. 47p. (IHR-109)

A precision solid state current shunt was constructed so that several magnets can be operated in series from the same precision power source but so that these magnets can be caused to carry different currents. The system is described and the theory discussed. The performance of a unit is evaluated. (M.C.G.)

1878 (HW-69667) SHEAR DEVELOPMENT FOR THE NONPRODUCTION FUELS REPROCESSING PROGRAM. Final Report. V. P. Kelly (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 26p.

A 40-ton hydraulic shear has been redesigned and incorporated in an integrated shear system to complete studies of the size-reduction of power reactor fuels. Blade life parameters and functional design were emphasized in the mechanical portion of these second-phase studies. The shear blade studies show that the two best moving blades are the male Vee blade made of silicon-manganese toolsteel (S-type); or the steel straight blade edged with cobalt alloy (Stellite 6). Water-submerged shearing conceived for the Hanford process to control dust, fires, and fuel temperature also offers three mechanical advantages: (a) the water lubricates the shear and transfer mechanisms; (b) mechanisms stay cleaner so that fewer jams and malfunctions occur; and (c) the presence of a water level in the shear feed trough is an infallible indication that the dissolver basket is properly positioned beneath the shear. The shear must be designed so that corrective action may be readily undertaken when the inevitable jams occur. Feasible techniques for shear maintenance can be developed for in-cell replacement of individual shear parts (e. g., blades), components, or the complete assembly. The component replacement approach is recommended to minimize handling of the massive shear frame since the stationary blade will be replaced less often then the moving blade. (auth)

1879 (NBS-TN-115) LOAD CARRYING CAPACITY OF GAS-LUBRICATED BEARINGS WITH INHERENT ORIFICE COMPENSATION USING NITROGEN AND HELIUM GAS. H. Sixsmith, W. A. Wilson, and B. W. Birmingham (National Bureau of Standards. Cryogenic Engineering Lab., Boulder, Colo.). Aug. 1961. 36p. (PB-161616).

A static flat plate test apparatus was used to determine the load carrying capacity of circular thrust plates. The load carrying capacities of nine different pad and orifice combinations were determined experimentally using nitrogen and helium gas as the pressurizing medium. Actual load as a function of plate separation curves were developed at plate supply pressures from 25 to 250 psig. Included are descriptions of the apparatus in addition to the curves which were developed for gas-lubricated bearing design. (auth)

1880 (NP-10970) SOLID FILM LUBRICANTS: AN ANNOTATED BIBLIOGRAPHY. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Sept. 1961. Contract AF 04(647)-673. 69p. (SB-61-48)

References (147) on laminar compounds, plastics, ceramics, and metal films for use as solid film lubricants are given to reports and U. S. and foreign journals from 1950 to June 1961. (P.C.H.)

1881 (NP-11021) SUMMARY OF DATA ON SANDWICH CONSTRUCTION. W. B. Vorhes (Chance Vought Aircraft, Inc., Dallas). May 18, 1960. 17p. (AER-EOR-12966).

A bibliography of design data on sandwich construction is presented. The 51 references are divided into 4 groups: stability, strength properties, testing and miscellaneous properties, and fabrication techniques. A discussion of structural joints is included. In addition, a section is presented which shows some typical design practices for ferrous, non-ferrous, and fiberglas sandwich construction. (M.C.G.)

1882 (ORNL-3189(p.227-9)) EXPLODING WIRE AEROSOL GENERATOR. F. G. Karioris and J. W. Youngblood (Oak Ridge National Lab., Tenn.).

An exploding-wire aerosol generator, consisting of a 4000-joule capacitor bank and a triggered sphere gap, was applied to the production of aerosols of 14 different metals by exploding them in air or argon gas. Particles are spherical and are predominantly in the range of 0.01 to 0.10 μ. An aerosol of isolated U_3O_8 particles was produced as the result of stirred settling to remove chains and agglomerates. (auth)

1883 (ORNL-TM-37) MODIFICATION OF ALLIED ENGINEERING CORPORATION MANIPULATOR TONG. F. L. Peishel and E. L. Hutto (Oak Ridge National Lab., Tenn.). Oct. 6, 1961. Contract W-7405-Eng-26. 6p.

A manipulator tong was modified to include an alpha seal at the slave end. This arrangement is used in conjunction with manipulators in a lead-shielded glove box to obtain protection from both gamma and alpha radiation. (auth)

1884 (SC-4652(RR)) PERFORMANCE OF A HIGH-VELOCITY PROPELLANT GUN FOR CONTROLLED IM-

PACTS. R. A. Graham, G. E. Ingram, and W. D. Ingram (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 8p.

The performance of an extensively modified U. S. Army 40-mm gun for producing controlled impacts is described. Various projectile velocities in the range of 200 fps to 3200 fps were achieved by varying the amount of a fast-burning propellant. The desired velocity may be varied in small increments. Impact occurs while the projectile is being guided by the bore of the gun, thus facilitating precise alignment between the impacting surface of the projectile and the target specimen. Evacuating the barrel between the projectile and target eliminates undesired air cushioning to insure a step function impact. Projectile velocity measurements are made just prior to impact. (auth)

1885 (SCR-431) POSITIONAL TOLERANCE TRAINING AIDS. P. A. Nicovich and R. O. Dell (Sandia Corp., Albuquerque, N. Mex.). Aug. 1961. Contract [AT(29-1)-789]. 12p.

An introduction is given to a method using training aids to implement a program on positional tolerancing, a modification in the dimensioning of engineering drawings. The training aids were designed for drafting personnel and can be equally effective in teaching the system to designers, machinists, and inspectors. (B.O.G.)

1886 (SCTM-164-61(14)) HANDY FORMULAS CONCERNING NARROW-BAND DELIVERY OF ENERGY STORED IN COILS OR CAPACITORS. C. S. Williams, Jr. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1961. Reprinted Oct. 1961. Contract [AT(29-1)-789]. 25p.

These formulas, expressed in terms of the load resistance and the derivative of the load reactance, give the fraction of the stored energy delivered to a load connected at some instant to an excited coil or capacitor as well as the bandwidth (presumed less than the center frequency) of the spectrum of the delivered energy. (auth)

1887 (TID-13170) A FINE FOCAL-SPOT X-RAY GENERATOR USING BETA-RAYS. Final Report. J. Kastner, M. W. Chisholm, M. H. Dickerson, R. J. Lambert, M. Moe, J. R. Parks, and E. Schmidt (Picker X-Ray Corp. Waite Mfg. Div., Inc., Cleveland). Mar. 15, 1961. Contract AT(11-1)-746. 79p.

The feasibility of developing an x-ray source powered by beta energy was investigated. Magnetostatic focusing of beta particles using permanent quadrupole magnets served to give a self-powered device for special applications. However, the ultimate efficiency of static focusing was limited and a more generally useful approach was the use of beta particles to provide fine focal spot x rays by field emission. Several ideas and techniques were developed including a simplified electrical analog for electron beams, ceramic wafer permanent magnet configurations, and encapsulation of radioactive material in the pores of anodized aluminum. (auth)

1888 (UCRL-9767) A LOW-SPEED SWINGING-BUCKET ULTRACENTRIFUGAL ROTOR. Frank T. Lindgren (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 17, 1961. Contract W-7405-eng-48. 13p.

A four-place swinging-bucket-type rotor, designed for use with either Spinco Model L or E ultracentrifuges, is described which employs full-size 6-ml and 9-ml $\frac{1}{2}$-in. preparative tubes. Operation with the 9-ml preparative tube provides a full 8-cm radial path for achieving either sedimentation or flotation under nearly ideal conditions. Useful application of this rotor may be anticipated up to rotor speeds of 20,000 rpm (mean force of 27,000 × g) with a safety factor of 3.5. (auth)

1889 (AEC-tr-4675) INVESTIGATION OF A HYDRAULIC SYSTEM HAVING A BODY MOVING WITHIN IT. A translation of "Issledovanie Gidravlicheskoi Sistemy s Dvizhushchimsya v Nei Telom." P. I. Bugakov, T. A. Gruzinova, R. R. Ionaitis, F. T. Kamen'shchikov, and D. N. Popov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 32p.

The processes occurring in a hydraulic circuit incorporating a vertical tube in which a cylindrical body is falling were investigated. Analysis of the hydraulic processes during the fall of the body showed that short duration falls with no liquid cavitation may be obtained through installation of a gas-liquid accumulator. Equations of motion for the liquid and the cylindrical body were derived. (J.R.D.)

1890 (AERE-Trans-874) HIGH-TEMPERATURE SEMI-CONDUCTOR THERMOCOUPLES. P. S. Kisly and G. V. Samsonov. Translated by L. F. Secretan (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Planseeber. Pulvermet., 8: 200-6(1961). 8p.

It is shown that a series of alloys of high-temperature semiconducting compounds of the type of boron carbide and chromium silicide with metal-like compounds show high values and a linear temperature relation of the EMF over the range of from 300 to 400°C up to 2000 to 2200°C, which makes it possible to make high-temperature thermocouples of the semiconductor type. A high-temperature thermocouple was made from molybdenum disilicide and boron-saturated graphite. The EMF of this thermocouple rose linearly over the range from 400 to 2000°C, from 4 to 45 μV, and stayed constant in the course of time. A series of thermocouples was made from boron-saturated graphite with carbides and borides of high-melting metals. They also showed a linear relation between EMF and temperature. It is shown that it is possible to make thermocouples with pre-determined electrical and mechanical properties. (auth)

1891 (SCL-T-372) AN AUTOCLAVE FOR ELECTROCHEMICAL INVESTIGATIONS. V. V. Gerasimov, A. I. Gromova, A. A. Sabinin, and E. T. Shapovalov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from "Avtoklav dlya Elektrokhimicheskikh Issledovanii." 1960. 10p.

An autoclave was constructed for electrochemical measurements at high temperatures and pressures. Anodic and cathodic polarization data are presented for IXI8H9T steel in water, sodium chloride solutions, and water saturated with hydrogen, air, or oxygen, at 300°C and 87 kg/cm^2 pressure. The thermodiffusional potential was found to be negligible. (D.L.C.)

1892 (UCRL-Trans-529(L)) MODEL APPARATUS FOR THE CONTINUOUS POLYETHYLENE PREPARATION BY USE OF ZIEGLER-COMPOUND-CATALYSTS. Siegfried Sommer, Siegfried Wagener and Helmut Ebner. Translated by Esther Fultz (Univ. of California Lawrence Radiation Lab., Livermore) from Kunststoffe, 49: 500-2 (1959). 12p.

The construction and operation of a model apparatus for the continuous preparation of low-pressure polyethylene by the use of Ziegler catalysts are described. (auth)

1893 (UCRL-Trans-733) DIFFRACTION LIGHT MODULATOR. A. M. Bonch-Bruevich and V. A. Molchanov. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Zhur. Tekh. Fiz., 25: 1653-8(1955). 7p.

The optimum conditions for light modulation were obtained and the principle of the ultrasonic modulator was developed. For the study of a diffraction modulator with standing waves in a liquid, an apparatus was chosen which permitted the observation of the diffraction pattern, the set of standing waves, and also to measure the amplitude of the variable component of the light emerging from the modulator. The difference of the modulation phase of the light which has passed through the various parts of the ultrasonic field was studied. (M.C.G.)

1894 USE OF FLANGED JOINTS IN LIQUID-METAL SERVICE. J. C. Clifford and George Burnet (Iowa State Univ. of Science and Tech., Ames). Chem. Eng., 68: No. 19, 179-80(Sept. 18, 1961). (IS-318)

Materials for the construction of flanged joints is discussed, and four flange designs, ring-joint, tongue and groove, raised-face, and modified tongue and groove, are evaluated. (P.C.H.)

1895 ATTAINMENT OF ULTRAHIGH VACUA, REDUCTION IN SURFACE DESORPTION, AND THE ADSORPTION OF HYDROGEN BY EVAPORATED MOLYBDENUM. Angus L. Hunt, Charles C. Damm, and Earl C. Popp (Univ. of California, Livermore). J. Appl. Phys., 32: 1937-41(Oct. 1961).

Deposition of molybdenum by vaporization from simple hairpin filaments was found to reduce pressures in both unbaked and moderately baked stainless steel vacuum systems to 4×10^{-10} mm Hg. A deposit of 300 mg from a single filament, 0.050 in. in diameter and 6 in. long, has maintained an unbaked 85-liter volume at pressures below 10^{-9} mm Hg for over 40 hr with the aid of a small well-trapped diffusion pump. For a substrate area of 8×10^3 cm^2, the initial pumping speed of a molybdenum deposit was found to be as high as 10^5 liters/sec for hydrogen and 8×10^4 liters/sec for deuterium. The sticking probability for either hydrogen or deuterium on this deposit is estimated at 0.3. A similar system, baked at 200°C for several days while pumped by an oil-free ion pump, attained 2×10^{-10} mm Hg with molybdenum evaporation. When the ion pump was valved off, the pressure in this 75-liter system remained at 2×10^{-10} mm Hg for two weeks with no external pumping. (auth)

1896 ALPHA-GAMMA "HOT" CELLS FOR ENTRY BY PERSONNEL. John M. Ruddy (Brookhaven National Lab., Upton, N. Y.). J. Structural Div., Proc. Am. Soc. Civil Engrs., 85: No. ST8, 125-34(Oct. 1959).

The basic engineering definitions and the effect of the philosophy of maximum set-up and maintenance directly by people on design criteria is discussed for this type of "hot" cell. An example of this kind of cell is described in broad outline. (auth)

1897 55% THREAD DEPTH WILL MAKE BERYLLIUM BOLTS PRACTICAL. Nicholas P. Chironis. Prod. Eng., 31: No. 47, 75-7(Nov. 14, 1960).

A thread form, employing threads with a large root radius and a thread depth only 55% of the theoretical, has improved remarkably the fatigue strength of bolts made from notch-sensitive beryllium. The fatigue strength is improved by reducing the stress concentrations. The design and performance of the bolts is presented and a comparison of the fatigue strength is made with steel and titanium bolts. (N.W.R.)

1898 IMPROVEMENTS IN OR RELATING TO DEVICES FOR THE SEALING OF A ROTATABLE SHAFT IN PASSAGE THROUGH A CASING. Stanley Whitley and David Shaun Allen (to United Kingdom Atomic Energy Authority). British Patent 881,877. Nov. 8, 1961.

A device for sealing a rotatable shaft in passage through a casing is designed which has a diametral clearance between the shaft and the sleeve so small that a small feed of sealing gas is sufficient and leakage rates are low. The device comprises a sleeve resiliently sealed to the casing and defining with the shaft an externally pressurized orifice zone for sustaining gas lubrication and support between sleeve and shaft. Grooves are also provided in the sleeve for adjusting the pressure and for a sealing gas feed which prevents mixing of pressurizing and process gases. (D.L.C.)

1899 IMPROVEMENTS IN IONIC PUMP. (to General Electric Co.). British Patent 882, 781. Nov. 22, 1961.

An ionic getter pump is designed for lowering the pressure of evacuated systems to values as low as 10^{-12} mm Hg. The pump works on the principle of ionizing the gas and entrapping the positive ions by sputtered metallic particles. (D.L.C.)

1900 IMPROVEMENTS IN OR RELATING TO ELECTROSTATIC PRECIPITATORS. (to Societe Financiere D'Expansion Commerciale et Industrielle S. A. "Sfindex"). British Patent 882,803. Nov. 22, 1961.

An improved electrostatic precipitator is designed for separating solid or liquid particles from gases. In this precipitator, the gas flow is first directed into an ionizer consisting of a grounded tubular counter electrode, and then into a separator consisting of a series of parallel plates. The advantage of this precipitator design is that high field intensities are possible with a short discharge wire. (D.L.C.)

1901 IMPROVEMENTS IN OR RELATING TO INTERCOMMUNICATION SYSTEMS. Thomas William Pollock (to United Kingdom Atomic Energy Authority). British Patent 883,182. Nov. 22, 1961.

An intercommunication system is designed which consists of a plurality of transmit/receive stations, each station being arranged to function when coupled to other stations. The advantages of the system are that any one station can transmit to all other stations simultaneously, the number of stations can be changed easily, the distance between stations is not unduly limited, and the signal-to-noise ratio is adequate. (D.L.C.)

1902 ELECTRICAL VACUUM PUMP AND VACUUM GAUGE APPARATUS. (to Varian Associates). British Patent 883,189. Nov. 22, 1961.

An improved electrical vacuum getter pump or gage is designed which is simple, gives extremely low pressures, and has increased pumping speeds. The pump comprises a closed envelope with cathode and anode structures for producing a glow discharge and with means for producing a magnetic field through the anode structure. The field imparts a cycloidal trajectory to the electrons of the discharge, thereby increasing chances of collisions with neutral gas molecules. The pump also may have a current measuring device which serves a monitor of the pump gas pressure. Several embodiments of the pump are described. (D.L.C.)

1903 ELECTRICAL VACUUM PUMP AND VACUUM GAUGE APPARATUS. (to Varian Associates). British Patent 883,190. Nov. 22, 1961.

An electrical vacuum getter pump, which may be used as a vacuum gage, comprises an anode structure surrounding a cathode structure. In operation, a glow discharge is struck between the structures, and a magnetic field is produced in a direction transverse to the electric field, so that the electrons are caused to take a curved trajectory and thus to have a greater probability of ionizing the neutral gas molecules. (For fuller discussion of the invention, see British Patent 883,189.) (D.L.C.)

Heat Transfer and Fluid Flow

1904 (AAEC/TM-94) THE A.A.E.C. ATMOSPHERIC PRESSURE HEAT TRANSFER RIGS. K. R. Lawther and A. Draycott (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1961. 23p.

Two atmospheric pressure rigs with associated equipment designed for investigating heat transfer and friction characteristics of different types of roughened surfaces to develop suitable surfaces for an HTGCR fuel element are described. Operating details are given together with techniques used to measure heat transfer and friction on a surface assembly incorporating selected roughened surfaces. Methods for calculating Stanton numbers, friction factors, and Reynolds numbers for such an assembly are included. (auth)

1905 (CNI-92) HEAT TRANSFER IN IRRADIATION CANS FOR THE ISPRA EXPERIMENTS. A. Gerosa and S. Moretti (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). July 1961. 50p.

Theoretical and experimental heat transfer characteristics of irradiation-cans of the type to be used in Ispra are discussed. Various can designs are analyzed under steady-state and transient conditions at 0 to 600°C, and the applications of these results to obtain specific heat transfer conditions within a can are discussed. (auth)

1906 (GEAP-3397(Add.)) FURTHER EXPERIMENTAL RESULTS ON NATURAL CIRCULATION LOOP PERFORMANCE AT 1000 PSIA UNDER PERIODIC ACCELERATIONS. E. P. Quinn (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 24, 1960. Contract AT(04-3)-189. 44p.

Experimental results on the effect of periodic acceleration on a natural circulation, 1000 psia, two-phase flow loop are presented and related to the topic of marine reactor design. The range of velocity variation that resulted from periodic acceleration was considerably greater than would be obtained from operation at corresponding steady accelerations. Heated element burnout levels were not decreased as a result of rocking the loop. Hydraulic oscillations occurred in the stationary loop when the two-phase pressure drop was increased. Hydraulic oscillations resulted at operation above critical levels of subcooling and heat input, when the loop was stationary. Natural hydraulic oscillations were eliminated by rocking at non-natural periods and the resulting flow variations were similar to those of a stable loop rocking at the same period. (auth)

1907 (GEAP-3703) HEAT TRANSFER COEFFICIENTS WITH ANNULAR FLOW DURING "ONCE-THROUGH" BOILING OF WATER TO 100 PER CENT QUALITY AT 800, 1100, AND 1400 PSI. E. E. Polomik, S. Levy, and S. G. Sawochka (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 1, 1961. Contract AT(04-3)-189. 105p.

Results obtained in a study of once-through heat transfer are presented. Sufficient data were obtained for preliminary design of once-through boilers in the regions of departure from nucleate boiling, transition to film boiling, and film boiling at 800, 1100, and 1400 psi. Results are presented graphically and analyzed. (J.R.D.)

1908 (IDO-14561) AIR LIFT PERFORMANCE AT LOW LIQUID RATES USING OVERSIZED PIPING AND LATERAL RUNS. H. V. Chamberlain (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Oct. 10, 1961. Contract AT(10-1)-205. 19p.

The use of oversized piping in an air lift for transferring solutions at rates less than 5 liters per hour was proven feasible with certain limitations. Reliable operation was also obtained with air lifts containing a lateral run inserted between the point of air injection and the final discharge point. Discharge of the air lifts, especially at low liquid flows, was very erratic under the conditions studied. (auth)

1909 (NYO-7809) HEAT TRANSFER IN BEDS OF ORIENTED SPHERES (thesis). David E. Baldwin, Jr. (Carnegie Inst. of Tech., Pittsburgh). Apr. 21, 1961. Contract AT-(30-1)-1945. 83p.

Experiments were performed to show how the fluid-solid heat transfer at various positions in beds of oriented spheres is influenced by a jet which impinges on the first row. Heat transfer coefficients were determined at several radial and axial positions in two arrangements of $1^{15}/_{16}$ inch spheres. One was a regular cubic arrangement with a void fraction of 0.478 and the other was a dense cubic orientation with a void fraction of 0.261. The heat transfer medium was pressurized water at about 240°F and a Reynolds number range of 3,000 to 70,000 was covered. The coefficients for individual spheres in the front rows of both beds were found to be influenced strongly by the radial position and the nature of the entering jet. The effect appeared to be dissipated completely ahead of the fifth row of the regular cubic bed and the third row of the dense cubic bed. Beyond these rows, over the entire range of Reynolds numbers investigated, the regular cubic arrangement yielded the relationship $j_H = 0.992\ Re^{-0.33}$ and the dense cubic arrangement yielded $j_H = 0.940\ Re^{-0.30}$. (auth)

1910 (SC-4646(RR)) PRESSURE RESPONSE IN A LONG TUBE WHICH IS CLOSED AT ONE END. M. D. Bennett (Sandia Corp., Albuquerque, N. Mex). Nov. 1961. Contract [AT(29-1)-789]. 26p.

An equation was derived that approximately describes pressure response in a long constant-diameter tube which is closed at one of its extremities. Numerical solutions are presented for several types of forcing functions. (auth)

1911 (TID-14189) THEORETICAL INVESTIGATION OF FLOW THROUGH AN APERATURE SOLUTION OF THE TWO-PHASE COMPRESSIBLE FLOW BY THE "HODOGRAPH TRANSFORMATION." Nuclear Reactor Containment Bimonthly Report No. 8. G. Gavalas (Minnesota. Univ., Minneapolis). Oct. 18, 1961. Contract [AT(11-1)-50]. 15p.

It was found that treatment of a two-phase mixture of liquid water and steam as a compressible fluid is possible provided the following assumptions are made: the mixture is homogeneous; the flow is isentropic; and the flow is two-dimensional, steady, and irrotational. A description of the problem in the Hodograph plane is presented along with a discussion of its applicability. Calculations of mass and momentum flow rates are presented. Treatment of metastable flows is discussed. (M.C.G.)

1912 (AEC-tr-4676) AN INVESTIGATION OF THE THERMAL CONDUCTIVITY OF A CHARGE OF SHOT IN VARIOUS GAS MEDIA. A translation of "Issledovanie Teploprovodnosti Zasypki iz Drobi v Razlichnykh Gasovykh Sredakh." P. I. Bugakov, V. S. Udalov, and Yu. P. Shlykov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1960. 14p.

Results of experiments in the study of thermal conductivity of a charge of cast iron shot (diameter 3 to 4 mm) in air, argon, nitrogen, and helium at temperatures up to 600°C are given. The investigations were conducted by a non-stationary method. (auth)

1913 THE PROBLEM OF THE CONTACT THERMAL RESISTANCE IN HEAT TRANSFER PHENOMENA TO LIQUID METALS. O. P. Astakhov, V. I. Petrov, and O. S. Fedynskii. Atomnaya Energ., 11: 255-7(Sept. 1961). (In Russian)

A study of the literature of the liquid-metal heat transfer problem indicates that experimental data do not agree well with the theoretical predictions of R. Martinelli and R. Lyon, especially when tubes with diameter of less than 10 mm are used in the heat exchanger. The discrepancy is due primarily to the contact resistance at the boundary between the solid tube wall and the liquid metal; its nature has not been sufficiently clarified up to now. The problem was reviewed theoretically, taking the flow conditions into account and assuming a supplementary thermal resistance at the boundary. While no new data were obtained, the calculation makes it possible to follow more conveniently the dependence of thermal resistance on the various parameters. (TTT)

1914 HIGH POWER HEATING OF A CYLINDRICAL TUBE BY ELECTRON BOMBARDMENT OF THE INSIDE SURFACE. R. E. Haigh and P. H. Dawson (Associated Electrical Industries (Manchester) Ltd., Manchester, Eng.). Brit. J. Appl. Phys., 12: 609-13(Nov. 1961).

The electron-bombardment method was used successfully to simulate reactor power ratings in heat transfer tests on a dummy fuel element, simulating conditions present in Calder Hall reactors. Power ratings that can be achieved are much higher than those obtained through conventional heating methods. The techniques required are already established in the manufacture of high-power valves and high-vacuum systems. (L.N.N.)

1915 SUPPLY AND REGULATION OF BOILER FEED-WATER. [PART II]. J. W. W. Shaw (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Control, 94-7(June 1961).

Methods of controlling reactor inlet temperatures and the effects of regulation on these temperatures are discussed. The Robot and Steadiflow feed regulators and their performances in the Calder Hall reactor are described. Data are presented graphically, and diagrams are given. (L.N.N.)

1916 SUPPLY AND REGULATION OF BOILER FEED-WATER. [PART I]. J. W. W. Shaw (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Control, 96-8(May 1961).

The method for replacing the steam generated by an equal quantity of water is discussed. It consists of high-pressure feed pumps forcing the water into the boilers and feed regulators adjusting the feed rate to match the steaming rate. Problems of supply and regulation in nuclear power stations are discussed, and principles of single-, double-, and triple-element regulators are briefly described. Feed regulation is discussed in relation to reactor control, and reference to the situation at Calder Hall is made. (L.N.N.)

1917 HEAT TRANSFER. J. K. Ferrell and T. M. Godbold (North Carolina State Coll., Raleigh). Ind. Eng. Chem., 53: 1025-30(Dec. 1961).

A review is given on the developmental activities of heat transfer from December 1959 through May 1961, with emphasis on the latter portion of the period. The problems of various phases of heat transfer are discussed, and references are given. A total of 146 references are given with book and proceedings references separated from references to journal items and reports. (P.C.H.)

1918 ON AERODYNAMICS OF RAREFIED GASES AND PROBLEMS OF HEAT TRANSFER. A. S. Predvoditelev (Moscow State Univ., U.S.S.R.). Intern. J. Heat and Mass Transfer, 3: 188-97(Oct. 1961). (In English)

Poor agreement between experimental data and theoretical expressions for acoustic dispersion in a rarefied gas which are obtained on the basis of the Burnett and super-Burnett solutions of the Boltzmann equation is shown; the classical theory based on the Navier-Stokes hydrodynamics brings more successful results. The above-mentioned appears to be valid also when considering a temperature jump and slip. Contradictions between the Euler equations and the molecular-kinetic theory are also revealed while considering the conformability of these equations to the rarefied gas. The generalization of the Euler equations is fulfilled by introducing a parameter of non-ideal continuity. (auth)

1919 HEAT TRANSFER: A REVIEW OF CURRENT LITERATURE. E. R. G. Eckert, T. F. Irvine, Jr., E. M. Sparrow, and W. E. Ibele (Univ. of Minnesota, Minneapolis). Intern. J. Heat and Mass Transfer, 3: 222-48(Oct. 1961). (In English).

A review is given of the literature published mostly in 1960. The review covers the following fields: conduction, channel flow, boundary-layer flow, flow with separated regions, transfer mechanism, natural convection, convection from rotating surfaces, combined heat and mass transfer, change of phase, radiation, liquid metals, low density heat transfer, measurement techniques, thermodynamic and transport properties, and heat transfer applications. The review on heat transfer contains over 400 references. (N.W.R.)

1920 DIMENSIONAL ANALYSIS OF BURNOUT HEAT TRANSFER. S. L. Bragg and I. E. Smith (Rolls-Royce Ltd., Derby, Eng.). Intern. J. Heat and Mass Transfer, 3: 252-3(Oct. 1961). (In English)

The burnout heat transfer rate equation is derived and explained. The explanation is given in terms of the frequency of bubble shedding and the instability of two-phase flow. A physical explanation of the form of the equation is that bubbles break away from the surface as soon as the buoyancy forces are greater than the surface tension forces holding them on; and that burn-out occurs when the buoyant acceleration of the bubbles away from the surface is no longer great enough to keep the bubbles clear of their successors. (N.W.R.)

1921 THE MOISTURE SEPARATION IN BWR. Hideo Fujie (Hitachi, Ltd., Japan), Hideo Yusa, and Naosi Aoki. J. At. Energy Soc. Japan, 3: 792-9(Oct. 1961). (In Japanese)

Experiments on steam separation were made to analyze the phenomena of moisture entrainment into steam from the steam—water mixture in steam generators, such as in boiling water reactors (BWR) and conventional shell and tube type steam generators. The height from the boiling surface to the steam outlet, the steam velocity above the boiling surface, and the pressure in the steam generator are considered as the most important factors with respect to the amount of moisture entrainment. Some clear correlations between the entrainment and these three factors were found in tests in which the pressure was varied from 1 to 70 atm, the steam velocity up to 2.0 m/sec, and the height up to 120 cm. The performances of corrugated plate type steam scrubbers were also tested at atmospheric pressure. The following facts were confirmed from the test results and the theoretical analysis based on some assumptions: The steam quality was almost independent of the height from the boiling surface to the steam outlet when the height is more than 60 cm. The steam quality was more deteriorated at the higher pressure. However, the quality, at least 99.9%, was obtained at the pressure of 70 atm. (auth)

1922 HEAT TRANSFER TO LONGITUDINAL LAMINAR FLOW BETWEEN CYLINDERS. E. M. Sparrow, A. L. Loeffler, Jr., and H. A. Hubbard (Lewis Research Center, National Aeronautics and Space Administration, Cleveland). J. Heat Transfer, 83: 415-22(Nov. 1961).

Consideration is given to the fully developed heat-transfer characteristics for longitudinal laminar flow between cylinders arranged in an equilateral triangular array. The analysis is carried out for the condition of uniform heat transfer per unit length. Solutions are obtained for the temperature distribution, and from these, Nusselt numbers are derived for a wide range of spacing-to-diameter ratios. It is found that as the spacing ratio increases, so also does the wall-to-bulk temperature difference for a fixed heat transfer per unit length. Corresponding to a uniform surface temperature around the circumference of a cylinder, the circumferential variation of the local heat flux is computed. For spacing ratios of 1.5 to 2.0 and greater, uniform peripheral wall temperature and uniform peripheral heat flux are simultaneously achieved. A simplified analysis which neglects circumferential variations is also carried out, and the results are compared with those from the more exact formulation. (auth)

1923 UNSTEADY LAMINAR FLOW IN A DUCT WITH UNSTEADY HEAT ADDITION. Morris Perlmutter and Robert Siegel (Lewis Research Center, National Aeronautics and Space Administration, Cleveland). J. Heat Transfer, 83: 432-40(Nov. 1961).

An analysis is made of transient heat transfer with transient laminar flow between heated (or cooled) parallel plates. The transient processes are caused by simultaneously changing the fluid pumping pressure and either the wall temperature or the wall heat flux. The solution is obtained for both the thermal entrance and fully developed heat-transfer regions. The slug-flow simplification is made; that is, the velocity at any instant of time is taken as uniform throughout the channel. The fluid temperature distribution, however, depends on both the axial co-ordinate and the position within the channel cross section. A few numerical examples are carried out which give some insight into various transient processes such as those occurring during a nuclear-reactor shutdown. (auth)

1924 AN EXACT SOLUTION OF THE COMPRESSIBLE-FLOW CHARACTERISTICS IN CONSTANT-AREA PASSAGES WITH SIMULTANEOUS FRICTION AND CONSTANT HEAT FLUX. R. N. Noyes (General Electric Co., Cincinnati). J. Heat Transfer, 83: 454-6(Nov. 1961).

An exact solution is presented for the flow of a compressible fluid in a constant-area passage in which wall friction is present and the total temperature of the fluid rises linearly with distance through the passage. For fluid properties that are invariant with temperature, this is specifically the case of constant heat flux. From this exact solution, an approximate simplified form is derived that should be applicable to predicting flow performance for most types of operation of constant-area heat exchangers. (auth)

1925 ON SOME LAMINAR FORCED-CONVECTION PROBLEMS. L. N. Tao (Illinois Inst. of Tech., Chicago). J. Heat Transfer, 83: 466-72(Nov. 1961).

The forced-convection problems in channels of fully developed laminar flow with heat sources and constant wall-temperature gradient are approached by the method of complex variables. It is shown that the stated problems are reduced to the determination of some analytic functions which satisfy the boundary conditions. Basic problems, including flows in equilateral triangular ducts and in elliptical tubes, are studied. It is shown that the cases of circular tubes and of parallel plates with a gap are directly deducible from that of elliptical tubes. All these solutions are expressed in closed forms by polynomials. (auth)

1926 UNSTEADY LAMINAR FREE CONVECTION. P. M. Chung and A. D. Anderson. (Ames Research Center, National Aeronautics and Space Administration, Moffett Field, Calif.). J. Heat Transfer, 83: 473-8(Nov. 1961).

The unsteady, laminar, free-convection boundary layer is analyzed with Grashof number considered to be time-dependent through either the uniform wall temperature or the acceleration field. Two geometries are considered; the vertical plate and the horizontal circular cylinder. A set of parameters is derived through which it is possible to describe the unsteady behavior of the boundary layer. These parameters allow solutions of the pertinent differential equations to be expressed in series form and an infinite number of sets of perturbation equations result. Numerical integrations of the first few sets are shown graphically. These results enable one to visualize and to calculate, quite readily, the time-dependent deviations from the quasi-steady velocity and temperature profiles as well as the deviation in heat transfer. (auth)

1927 RADIANT INTERCHANGE BETWEEN CIRCULAR DISKS HAVING ARBITRARILY DIFFERENT TEMPERATURES. E. M. Sparrow. (Univ. of Minnesota, Minneapolis) and J. L. Gregg. J. Heat Transfer, 83: 494-502(Nov. 1961).

The problem of radiant heat transfer between parallel disks was analyzed by generalizing the standard gray-body enclosure theory. In particular, the assumption that the radiant flux leaving a surface and the local heat flux are uniformly distributed over the surface was lifted by an integral equation formulation. It was shown that the general problem of disks at arbitrarily different temperatures can be conveniently broken down into two subproblems, each of which can be solved independently of the temperature level. Numerical solutions of the governing integral equations were carried out for spacing ratios h/R (h = spacing, R = disk radius) ranging from 5.0 to 0.05 and for emissivities ranging from 0.1 to 0.9. Local heat-transfer results were presented which, depending on spacing and emissivity, display marked variations over the disk surface. Over-all heat-transfer results were calculated and compared with the predictions of the standard simplified enclosure theory. These predictions of the simplified theory were found to be unexpectedly good, especially in view of the large surface variations of the local heat transfer. (auth)

1928 HEAT CONDUCTION IN AN ECCENTRICALLY HOLLOW, INFINITELY LONG CYLINDER WITH INTERNAL HEAT GENERATION. M. R. El-Saden (North Carolina State Coll., Raleigh). J. Heat Transfer, 83: 510-12(Nov. 1961).

The steady temperature distribution in an infinitely long, eccentrically hollow cylinder with uniform rate of internal heat generation is discussed. An exact theoretical solution is presented. The result is applied to the special case of no internal heat generation, and the rate of heat conduction is obtained. (auth)

1929 A GENERAL METHOD OF DERIVING RESPONSES AND TRANSFER FUNCTIONS IN TRANSIENT

HEAT CONDUCTION PHENOMENA. R. K. Thomasson (Dounreay Experimental Reactor Establishment, Caithness, Scotland). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 91-7(Oct. 1961).

A method of solving unsteady heat conduction problems is described. The solution is obtained by first finding the eigenvalues and eigenfunctions of an integral equation. Once these are obtained it is possible to obtain ordinary differential equations or transfer functions describing the response to various disturbances in heat production and extraction. The method may be applied to cases where the heat flow can be treated as one-dimensional, and it may be extended to cover two-dimensional cases. As an example of the use of the method, the temperature responses of a fast reactor fuel pin to power changes and coolant temperature changes are derived. (auth)

1930 THE STABILITY OF VISCOUS FLOW IN A CURVED CHANNEL IN THE PRESENCE OF A MAGNETIC FIELD. S. Chandrasekhar, Donna D. Elbert, and N. R. Lebovitz (Univ. of Chicago). Proc. Roy. Soc. (London), A264: 155-64(Nov. 7, 1961).

The stability of viscous flow between two coaxial cylinders maintained by a constant transverse pressure gradient is considered when the fluid is an electrical conductor and a uniform magnetic field is impressed in the axial direction. The problem is solved and the dependence of the critical number for the onset of instability on the strength of the magnetic field and the coefficient of electrical conductivity of the fluid is determined. (auth)

1931 RESEARCH ON THE THERMAL RELAXATION IN NOZZLE FLOW BY ANALYSIS OF THE GAS KINETIC RATE DISTRIBUTION. O. Hagena and W. Henkes (Kernforschungszentrum, Karlsruhe, Ger. and Technische Hochschule, Karlsruhe, Ger.). Z. Naturforsch., 15a: 851-8 (1960). (KFK-38) (In German)

The thermal relaxation was obtained in the production of ultrasonic flow in the transitional region between gas dynamic and molecular flow mode from the rate distribution of molecular radiation, which was obtained by means of transfer of the ultrasonic flow in high vacuum. The rate distribution was determined by a transition-time method. The method was applied to UF_6 and CO_2 which showed in the first case a strong, in the second on the contrary practically no pressure dependence of the accommodation degree on the total energy. (tr-auth)

Instrumentation

Refer also to abstracts 1317, 1792, 2715, and 2779

1932 (AAEC/E-73) IMPERMEABLE GRAPHITE AS A FUEL CAN. PART 2. APPARATUS FOR THE MEASUREMENT OF PERMEABILITY. G. C. Wall (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1961. 18p.

An apparatus is described which is capable of measuring permeabilities of porous media down to 4×10^{-11} cm^2 sec^{-1} with a maximum error of 10%. The method, which uses a radioactive tracer technique, eliminates the errors due to gas leakage which are inherent in conventional apparatus for permeability measurement. (auth)

1933 (AAEC/TM-76) TRANSISTOR COUNTING-RATE METERS. A. G. Klein (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1959. Re-issued Feb. 1961. 13p.

The use of transistors in counting-rate meters has so far been restricted mainly to portable health and survey type monitors. This report points out that transistors may be used sucessfully in rate-meters of high accuracy and gives examples of practical circuits which may be designed to attain accuracies and linearities of better than ±1%. (auth)

1934 (AD-255935) PLASTIC SCINTILLATION COUNTING FOR CONTINUOUS FLOW SYSTEMS. Interim Report. Ralph S. Goldsmith, Leonard G. Seraile, and Travis S. Masterson, Jr. (Brooke Army Medical Center, San Antonio). Mar. 1961. 13p. (MEDEW-RS-2-61)

A plastic spiral scintillation flow counter is described for use with chromatographic columns. The spiral is sensitive to beta emission and can be used for low energy isotopes such as C^{14}. A device for determining activity in individual fractions obviates the need for preparing all fractions for counting by other techniques. (auth)

1935 (AFSWC-TN-61-5) TEST RESULTS, NUCLEAR RADIATION MEASURING, AND RECORDING SET, A/E 33-D-1 (XV-1). Alvin E. Smith (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Apr. 1961. 18p. (AD-256743)

The operation, performance, and various tests conducted on the Nuclear Radiation Measuring and Recording Set, A/E 33D-1 (XV-1) are described. The radiation response and environmental test procedures and parameters are described and their results are presented. The set failed the high and low temperature and lower energy radiation response testing. The major engineering problem areas are discussed. (auth)

1936 (CERN-61-25) A SPARK CHAMBER HODOSCOPE. G. Culligan, D. Harting, and N. H. Lipman (European Organization for Nuclear Research, Geneva). Sept. 26, 1961. 22p.

A single gap spark chamber was developed having a total thickness which may be as little as 40 mg/cm^2. The plates are constructed of a fine stainless steel wire mesh, which has a transmission to light of 46%. The chambers are used as hodoscopes, the sparks being photographed through the mesh. They may frequently be used in the type of experiment which normally requires a large array of scintillation counters. Detailed measurements were made of the characteristics of these chambers, and they have proved robust and reliable in their operation. They have a detection efficiency of higher than 99.4%, a time resolution of 0.6 μs, and a spatial resolution of better than 2 mm. The probability that the chamber produces a spurious spark is less than 1 in 10^4. (auth)

1937 (CREL-1036) A MAGNETIC-TAPE RECORDING SYSTEM FOR NEUTRON TIME-OF-FLIGHT ANALYSIS. T. K. Alexander and J. Leng (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 95p. (AECL-1322)

A neutron time-of-flight analyzer consisting of a magnetic-tape system and a ferrite-core analyzer provides 16,200 channels capable of handling a counting rate of 100 c/s. The system consists of a recording station and an "off line" reproducing and analyzing station including a 900-channel analyzer for fast sorting. The two magnetic-tape transports match the input counting rate to the speed of the analyzer making the whole system capable of handling the large number of channels, so that no backlog of data occurs at the input to the analyzer. The magnetic-tape transports handle 1¼ in. tape on which 24 tracks are recorded. The 24-bit words are recorded in NRZ code at a packing density of 250 words/in. The recording speed of the tape is 0.45 or 0.9 in./s and the reproducing speed is 30 in./s. The system can handle 30 neutron detectors each with 270 time-of-flight channels. In addition, short target runs and background runs are interleaved on a time-sharing basis. Codes, automatically changed and written on the tape, enable the reproducer to separate the interleaved data. The last facility is part of a control system that ensures continuity between the recording and reproducing stations through codes written on the magnetic tape. (auth)

1938 (DOFL-TM-60-42) NEUTRON DOSIMETRY IN THE 10 TO 600 Kev ENERGY REGION. John S. Ingley (Diamond Ordnance Fuze Labs., Washington, D. C.). Oct. 10, 1960. 8p.

A method for measuring neutron flux in the 10 to 600 kev energy region by means of threshold detectors utilizing inelastic scattering threshold reactions is discussed. The results of a search through the nuclide charts for suitable isotopes are presented. The main points in need of further investigation are mentioned, namely: accurate cross section data including competing reaction cross sections, cost of isotope separation or possibility of using elemental form, and the most efficient counting techniques for each isotope. (auth)

1939 (NP-10712) PORADNIK DEFEKTOSKOPII IZOTOPOWEJ. (Guide for the Isotope Defectoscope). Władysław Listwan and Marek Dobrowolski (Poland. Biuro Urzadzen Techniki Jadrowej, Warsaw). [nd.] 62p.

The characteristics and uses of the Isotope Defectoscope, a radiographic device developed for application in Polish industry, are described. Basic descriptions are given of the radiation-absorbing effects of materials, and the resultant effects of penetrating radiation on radiographic film emulsions. General descriptions of radioactive sources and their holders are given. Preparation of the materials to be radiographed is explained, and arrangement of the analysis equipment is described. Methods for determining the intensity of the source to be used in a particular situation are explained in detail. The procedures for analyzing the data on the radiograms and the readers used with radiographic films are described. The three types of defectoscopes produced in Poland are: "Rurowy," SzT-834, and DI-7. The first is a pipe-line instrument, and it is used mainly for special purposes. The other two are general purpose devices. The construction, uses, and operating parameters for each type of defectoscope are described in detail. Some examples of actual radiographic analyses, complete with the operational data and films, show the efficiency and applicability of the equipment used. (R.P.R.)

1940 (NP-10988) CINETIQUE DE DEVELOPPEMENT DES TRACES AU MINIMUM DANS LES EMULSIONS NUCLEAIRES. (Kinetics of the Development of Tracks at Their Minimum in Nuclear Emulsions). H. D. de Caravalho and A. G. da Silva (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1960. 10p. (Notas de Física, Vol. VII No. 2, p.13-21).

A study was made to determine if certain well-known laws of the kinetics of development, applicable to ordinary photographic emulsions, can be applied to Ilford G-5 emulsions. A study was first made to determine if the development speed at the ionization minimum can be satisfactorily represented by the equations of Sheppard, Mees, and Nietz. The results are in good agreement with the Sheppard equation. The effect of temperature on development speed can be expressed by the Arrhenius equation for the effect of temperature on a chemical reaction. (J.S.R.)

1941 (ORNL-3189(p.140-54)) THEORETICAL PHYSICS OF DOSIMETRY. J. Neufeld, P. H. Doyle, et al. (Oak Ridge National Lab., Tenn.).

Fundamental investigation of the properties of classical plasmas was continued. A new instability in the interaction of a beam and a stationary plasma was discovered. A phenomenological description of the space dispersive properties of plasma, based on the existence of the Doppler effect, is given. The emission of optical photons from solids irradiated by charged particles was analyzed theoretically, and a code for detailed computation was written. Interest in the analysis of swarm experiment data on the transport of electrons in gases led to the computation of equilibrium distribution functions in diatomic gases employing theoretical predictions of relevant cross sections available in the literature. A new method of analyzing swarm data in polyatomic gases is proposed and is being tested numerically. Monte Carlo results or the computation of neutron penetration in an air-over-ground geometry is given. A generalized principle of radiation dosimetry is formulated and examined in a number of special cases. (auth)

1942 (ORNL-3189(p.155-66)) EXPERIMENTAL PHYSICS OF DOSIMETRY. R. D. Birkhoff, E. T. Arakawa, et al. (Oak Ridge National Lab., Tenn.).

The spectral distribution of the light emitted from foils irradiated by electron beams was measured. It was found that the "color" of the light depends strongly on the metal being studied, the thickness of the foil, the beam energy, and the angle of observation. Experimental results are in approximate agreement with a theory based on the exchange of energy between the beam electrons and the conduction electrons of the foil acting collectively. Such collective interactions are thought to occur in irradiated biological systems as well. (auth)

1943 (ORNL-3189(p.166-71)) DOSIMETRY METHODS. F. J. Davis, A. E. Carter, et al. (Oak Ridge National Lab., Tenn.).

A fast neutron dosimeter was developed using a silicon-gold surface barrier to detect fission recoils from a foil containing U^{235}, Np^{237}, and U^{238}. Proper choice of the mass ratios and shielding with B^{10} produced a response which gives a direct indication of fast neutron tissue dose. Extensive airborne measurements of plane and point ground sources of gamma radiation were carried out at the Nevada Test Site. The dependence of spectral distributions and gamma ray intensity with altitude was developed, and is useful in connection with airborne surveys of radioactivity. (auth)

1944 (ORNL-3189(p.172-9)) DOSIMETRY APPLICATIONS. J. A. Auxier, J. S. Cheka, et al. (Oak Ridge National Lab., Tenn.).

The primary objective of the Dosimetry Applications Group is the accumulation of radiation exposure data for humans as a part of the Nuclear Energy Civil Effects Program. Specific projects include the "Ichiban" project to determine the radiation exposure of the survivors of the nuclear bombings of Hiroshima and Nagasaki, Japan, and the nuclear accident studies. Related work includes the development of special radiation measurement instruments and techniques, special shielding studies, and the research at the Fast Burst Reactor at ORNL. Progress includes the development of neutron and gamma spectrometers, better gamma dosimeters for mixed radiation dosimetry, and preparation for extensive experiments at the Nevada Test Site in late 1961. (auth)

1945 (ORNL-3189(p.222-4)) THE ORNL IN VIVO GAMMA-RAY SPECTROMETER FACILITY. B. R. Fish, P. E. Brown, et al. (Oak Ridge National Lab., Tenn.).

The ORNL whole-body counter, in operation with a 4 × 4-

in. NaI(Tl) crystal since June 1960, is now shut down during the changeover to an 8 × 4-in. NaI(Tl) crystal system. An auxiliary scintillation counter, having the same shielding as the big room, is used to monitor for transient changes in the general background. Air from the room is treated and recirculated, with makeup air being provided from cylinders of aged breathing-air. Of the 208 persons checked in the routine program, 7.2% showed gamma spectra different from those of unexposed individuals; furthermore, the most significant internal deposit was less than 20% of the maximum permissible body burden (Hg^{203}). (auth)

1946 (ORNL-3189(p.232-4)) A STUDY OF METHODS FOR MONITORING THE I^{131} CONTAMINATION IN THE ENVIRONMENT. J. W. Youngblood, P. E. Brown, et al. (Oak Ridge National Lab., Tenn.).

Beef-cattle thyroid samples and samples of pasture grasses were collected from areas within a 100-mile radius of ORNL and analyzed for I^{131}. Although the grass samples generally did not contain detectable amounts of I^{131}, 85% of the thyroid samples did show measurable amounts. A general ambient level of 2 μμc per gram of thyroid was observed at large distances from ORNL, and this level remained essentially unchanged from July 1960 through October 1960. The amounts of I^{131} expected to be deposited on the ground were calculated using stack release data and a modified form of Sutton's equation. For sampling stations in the prevailing wind directions, the ratio of the total amount of I^{131} found in the thyroid to the predicted deposition per square meter averaged 550. There was a general decrease in the amounts of I^{131} in cattle thyroids after November, possibly a result of increased supplementary feeding during the winter months. (auth)

1947 (REIC-Memo-23) RADIATION DOSIMETRY: AN ANNOTATED BIBLIOGRAPHY. Mary Jane Oestmann (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Sept. 15, 1961. Contract AF33(616)-7375. 63p.

An annotated bibliography on dosimetry of gamma, neutron, and mixed field irradiations is presented. Chemical and colorimetric systems are included along with colorimeters, photographic methods, neutron foil techniques, and irradiation test methods. (677 references.) (J.R.D.)

1948 (RISO-30) A GENERAL PURPOSE PULSE AMPLIFIER. K. B. Hansen (Denmark. Atomenergikommissionen. Forsogsinstitut, Riso). Sept. 1961. 12p.

An amplifier for use in the linear pulse technique is described. The design was based on the use of voltage parallel feedback and its specifications are such that different feedback impedances may be used. It may be employed as a preamplifier as well as a main amplifier. The circuit and components for the amplifier are described. The uses of the amplifier are discussed. (M.C.G.)

1949 (UCRL-9853) A SIMPLE, TRANSISTORIZED BETA-GAMMA HAND AND SHOE MONITOR. Robert J. Walker and William J. Roach (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 27, 1961. Contract W-7405-eng-48. 5p.

Hallogen-quenched G-M tubes are used as detectors. The hand array consists of four tubes while the shoe array consists of two tubes for each shoe. The bulk of the circuitry is printed and is similar to formerly-used designs. (J.R.D.)

1950 (UCRL-9861) A FAST-NEUTRON ACTIVATION DETECTOR FOR 14-Mev PULSED NEUTRON SOURCES. Lawrence Ruby and Joseph B. Rechen (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 15, 1961. Contract W-7405-eng-48. 10p.

A fast-neutron activation detector is described in which the gamma rays resulting from the decay of Pb^{207m} are observed in a plastic scintillator. The Pb^{207m} is produced by fast-neutron activation of a lead shield which surrounds the scintillator and photomultiplier. Following a 20-msec delay from the neutron pulse, the Pb^{207m} activity is observed for 2.40 sec. A source of Ba^{133} is used to check the gain stability of the detection system. The detector is observed to have somewhat higher sensitivity than a standard silver activation detector. (auth)

1951 (AEC-tr-4141(p.79-90)) CONSTRUCTION OF METAL GEIGER-MÜLLER COUNTERS. Z. Buja, A. Oleś, and K. Ostrowski. Translated from Nukleonika, 2: No. 2, 321-34(1957).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3078.

1952 (AEC-tr-4701) RESOLUTION OF SEVERAL QUESTIONS ABOUT THE TIME AND AMPLITUDE ANALYSES OF IMPULSES WITH THE AID OF SPECIAL MEMORY DEVICES. A translation of "Reshenie Nektorykh Voprosov Vremennogo i Amplitudnogo Analiza Impul'sov s Pomshch'yu Spetsial'sykh Ustroistv Pamyati." A. P. Tsitovich (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 15p.

Various types of memory arrangements on magnetic drums and cathode-ray tubes are considered in application to interval analyzers for neutron spectrometers. A method is suggested for increasing the speed of an amplitude analyzer by dynamic arrangement of the memory. A method is given for investigation of the relation between impulses in a memory tube. (auth)

1953 (NP-tr-813) ON THE LIMITS OF X-RAY FILM SENSITIVITY. J. Franzen. Translated by M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 94: 409-20(1961). 22p.

The need for a reduction of the radiation dose in medical diagnostics necessitates a re-examination of all margins which are still available. In this context, experiments were carried out on such margins in the photographic emulsion, and chemical fields. The theoretical bases of true and apparent increases in the sensitivity of the photographic emulsion are discussed and the analogous gains in sensitivity on the chemical side. The limits of these methods are investigated by a comprehensive series of tests. The results of the experiments are discussed and presented pictorially. (auth)

1954 (SCL-T-384) THE DEVELOPMENT OF THE ELECTRON ULTRAMICROSCOPE WITH ELECTROSTATIC LENSES. E. Brueche. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from VDI Zeitschrift, 85: 221-8(Mar. 8, 1941). 35p.

The historical development of the ultramicroscope is reviewed. Present-day types of electron microscopes and ultramicroscopes are outlined. The principles of electrostatic and electromagnetic electron optics are examined. The construction and features of an electrostatic-lens electron ultramicroscope is described. The performance of this microscope is compared with that of a microscope using electromagnetic lenses. (T.F.H.)

1955 (UCRL-Trans-734) SOME PROBLEMS OF PHASE MEASUREMENTS. A. M. Bonch-Bruevich and V. I. Shirokov. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Zhur. Tekh. Fiz., 25: 1825-42(1955). 26p.

The general problems of phase measurements were considered. Methods of determining the phase difference between two signals are discussed. The use of a phase amplifier is described. Phase and frequency relations in the pre-indicator equipment, amplitude and phase relations in pre-indicator apparatus, and fluctuation interference with phase measurements are discussed. (M.C.G.)

1956 GENERAL PROBLEMS CONNECTED WITH THE USE OF SCINTILLATION COUNTERS FOR MEASURING TIME INTERVALS. N. Vîlcov (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 211-16(1961). (In Rumanian)

The influence of the material used, the electronic photomultiplier, and the measuring circuit on the resolution of time interval measurements by scintillation counters are reviewed. Different values may be obtained for the duration of the scintillation for different samples of the same material because of the effect exerted by external factors such as the type of radiation, the temperature and the purity of the sample. The form of the anodic current pulse corresponding to a scintillation depends on the relationship between the duration of the scintillation and the time-of-flight of the electrons in the photomultiplier. In the design of the measuring circuit care must be taken to keep the parasitic capacitance as low as possible. The measuring circuit records the pulse when its instantaneous value exceeds the discrimination threshold, therefore amplitude fluctuations are noted by time fluctuations. (TTT)

1957 A COMPACT CASCADE IMPACTOR FOR FIELD SURVEY SAMPLING. Morton Lippmann (Health and Safety Lab., AEC, New York). Am. Ind. Hyg. Assoc. J., 22: 348-53(Oct. 1961).

A new design for a cascade impactor is presented. Particulate material is collected at four impaction stages on two standard 1 × 3 in. glass microscope slides, with two deposits on each slide. The deposits can be spread out during collection by using an external slide movement mechanism. A 1 in. diameter filter follows the impaction stages. A calibration nomograph is presented. Results obtained using this calibration are in good agreement with the results obtained by direct sizing of simultaneously drawn membrane filter samples. (auth)

1958 A BETA-BETA COINCIDENCE SPECTROMETER OF THE INTERMEDIATE IMAGE FOCUSING TYPE. Carl Johan Herrlander and Hilding Slaetis (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 41-69(1961). (In English)

A short review of earlier conversion line coincidence spectrometers is given. In the new beta-beta coincidence spectrometer the energy selection is made by means of two iron-yoked intermediate image spectrometers of a new type. These spectrometers permit the source and the detectors to be placed outside the iron yokes in regions where the magnetic field is practically zero, thus making the mutual influence of the spectrometers negligible. The design and the focusing experiments are treated in detail. Typical values for the transmission and the resolution are presented. For coincidence measurements two automatic gain control amplifiers and a fast coincidence unit are used. The spectrometers are also run in tandem, thus one of the detectors is exchanged for a sample, whereupon the electrons traversed both of the spectrometers. In this way it seems possible that the resolution can be increased by a factor of two. (auth)

1959 A SCANNING GRATING SPECTROGRAPH WITH A LEAD-SULPHIDE DETECTOR. I. THE EXPERIMENTAL EQUIPMENT. Ingmar Johansson and Nils Starfelt (Univ. of Lund, Sweden). Arkiv Fysik, 20: 147-52(1961). (In English)

A scanning spectrograph with good resolving power intended for the measurement of atomic emission lines in the near infrared is described. The infrared radiation dispersed by a rotating grating is detected by a lead sulfide photoconductive cell. A wave-number scale is obtained by recording interference peaks from a Fabry-Perot interferometer irradiated by white light dispersed in the spectrograph. (auth)

1960 A SCANNING GRATING SPECTROGRAPH WITH A LEAD-SULPHIDE DETECTOR. II. THE METHOD OF WAVELENGTH DETERMINATION. Ingmar Johansson (Univ. of Lund, Sweden). Arkiv Fysik, 20: 153-9(1961). (In English)

The method of wavelength determination is described. An analysis of the sources of errors and a discussion of the attainable accuracy is also given. (auth)

1961 SILICON COUNTERS FOR NUCLEAR SPECTROMETRY. S. M. Ryvkin, L. V. Maslova, O. A. Matveev, N. B. Strokan, and D. V. Tarkhin. Atomnaya Energ., 11: 217-20(Sept. 1961). (In Russian)

New types of silicon counters were developed. These small counters had a pulse amplitude of about 1 millivolt/Mev with a discrimination of less than 1% for E = 5.5 Mev. The counters were prepared by vapor-coating n-type Si with Au or diffusing P into p-type Si. The volt-ampere characteristic curve was the usual one for the n-p junction type material. The pulse amplitude, determined by the sensitive layer was proportional to charge. In addition to counting α-particles, these n-p semiconductor counters are useful for counting fast and slow neutrons if the nuclear reaction results in the formation of heavy charged particles. (TTT)

1962 DISTURBANCE OF RADIOACTIVITY MEASUREMENT IN ELECTROSTATICALLY ISOLATED DUST SAMPLES AS A RESULT OF EXOELECTRON EMISSION. W. Fett (Freien Universität, Berlin). Atompraxis, 7: 353-8(Oct. 1961). (In German)

The behavior of exoelectrons, which are formed on the isolation surface in a collection of electrostatic dust samples, and the practical consequences in measurements of radioactivity are discussed. (P.C.H.)

1963 RECORDING MICRO-DENSITOMETER EMPLOYING BETA-RADIATION FROM A CARBON-14 RADIOISOTOPE SOURCE. R. A. Lloyd and E. H. Adams (Wantage Research Lab., Berks, Eng.). Brit. J. Appl. Phys., 12: 614-17(Nov. 1961).

The variation of wood density through the thickness of individual growth rings of trees is of interest in research on growing of trees and utilization of the timber. An experimental instrument was developed in which a finely collimated beam of carbon-14 beta-particles is used to measure the density variations along thin longitudinal sections cut with a microtome from radial core borings obtained from the trunks of standing trees. The response of the instrument is linear for densities up to at least 1.0 g/cm^3 with sections 100 μ thick, and density discontinuities 0.05 mm apart can be resolved. Density changes of 3.5% can be detected, at a speed of traverse of 0.5 mm/min. The instrument may well be applied to other materials. (auth)

1964 METHOD OF MEASURING THE GROWTH OF A CONTROL SPECIMEN OF GRAPHITE AFTER IRRADIATION. P. A. E. Crosse and W. L. Snowsill (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Brit. J. Appl. Phys., 12: 637-9(Nov. 1961).

A method is described for measuring the length of control specimens of graphite accurately without placing any reliance on the condition of the surfaces of the graphite. A specially shaped groove is turned near each end of the 10-cm long × 1.25-cm diameter specimen, and is filled with flame-sprayed Magnox. A technique is described for producing a high-quality surface on the Magnox on which a diamond indentation under microscopic examination appears as a pair of cross wires. Using the 'cross wires' as datum marks, and a high-quality traveling microscope, measurements to an accuracy of 1 in 25,000 are readily attainable. Methods are discussed for increasing this to a possible 1:100,000. (auth)

1965 THE β RAY SPECTROMETER OF THE NUCLEAR PHYSICS CENTER AT LIÈGE. M. Legros (Centre de Physique Nucléaire, Liège) and G. Gueben. Bull. sci. A. I. M., (Belg.), No. 2, 183-200(Feb. 1959). (In French)

The principle, conception, and the accomplishment of a longitudinal magnetic field spectrometer, which is used for the study of beta emiters at the Nuclear Physics Center, Liege, France, is discussed. It is shown how the stabilization of the magnetic field was accomplished. (P.C.H.)

1966 DETERMINATION OF SHRINKAGE COEFFICIENT OF NUCLEAR EMULSIONS. Vratislav Havlovic (Inst. of Medicine, Pilsen, Czechoslovakia). Ceskoslov. casopis pro fysiku, A 11: 390-6(1961). (In Czech.)

A critical evaluation of the methods of determining the shrinkage coefficient of nuclear emulsions is made. The shrinkage coefficient for a nuclear emulsion Agfa K-2 for 60% relative humidity of the air was determined by the direct method of measuring the thickness of the emulsion before and after developing. Greenberg and Haslam's method of indirect determination was used for the same purpose, the results agreeing with those obtained by measuring the shrinkage coefficient by the direct method. The great dependence of the thickness of the nuclear emulsion and thus of its shrinkage coefficient on the air humidity is experimentally confirmed. (auth)

1967 ABSOLUTE MEASUREMENT OF HIGH-ENERGY X-RAY INTENSITY. Zdenek Kovar (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Českoslov. časopis pro fysiku, A 11: 417-35(1961). (In Czech.)

A brief description and evaluation of present-day ionization and calorimetric methods for the absolute measurement of the intensity of x rays having higher energies is given. Emphasis is on the advantages of calorimetric measurements. Calorimeters permit the direct measurement of the intensity in energy units and can serve to standardize measurements and to calibrate other dosimetric instruments. (auth)

1968 TUNNEL DIODES. STABILIZE COINCIDENCE CIRCUIT. C. Infante and F. Pandarese (Labortori Nazionali Di Frascati, Rome). Electronics, 34: No. 46, 133-5 (Nov. 17, 1961).

Performance requirements for a coincidence circuit to be used in high-energy physics experiments were obtained using tunnel diodes. The high ratio of loop gain-band-width to loop delay obtainable with these inherently regenerative devices permitted design of a circuit in which timing jitter is limited to a few nanoseconds. (L.N.N.)

1969 A DEVICE FOR THE MEASUREMENT OF THE DISTRIBUTION OF THE SLOW NEUTRON FLUX. D. Brini, A. Fubini, M. Missiroli, and A. Salomoni (Università, Bologna). Energia nucleare (Milan), 8: 588-93(Sept. 1961). (In English)

A simple device which is able to measure the relative distribution of slow neutron flux with the induced radioactivity method is described. Such a device gives a stability sufficient to put in evidence variations in $K_\infty - 1$ of the order of some percent. The tests, made for about 700 hours, showed a slow drift of about 1 to $2^{0}|_{00}$, which is not greater than the statistical errors. (auth)

1970 A NEW SAMPLE CHANGER FOR A GRIDDED IONIZATION CHAMBER. Tadayoshi Doke (Rikkyo Univ., Tokyo), Kiso Awamura, and Atsushi Nakamoto. Energia nucleare (Milan), 8: 599-600(Sept. 1961). (In English)

A simple sample changer is described and illustrated. Two sample store boxes are installed in the backside of a disk which is a part of the cathode in the chamber. The disk is demountable so that the old samples in the boxes can be changed easily with renewed samples. One of the store boxes is for unmeasured samples and the other for measured. The samples stored in the box are always pushed up by a spring fixed at the bottom of the box and the uppermost sample is faced to the detecting space in the chamber. However, once the sample has entered the box, it cannot be returned to the measuring site. (P.C.H.)

1971 NUCLEAR GAMMA-RAY SPECTROSCOPY BY CRYSTAL DIFFRACTION. Jesse W. M. DuMond and Edward J. Seppi (California Inst. of Tech., Pasadena). Hilger J., 6: 48-55(June 1961).

The transmission-type bent-crystal focusing spectrometer is described. The ideal perfectly focusing solution and the approximate solution of Cauchois are given. Methods are discussed, and schematics are given. A list of spectrometers using these principles is presented, and design and performance of some of these are discussed. (L.N.N.)

1972 AN AUTOMATIC RECORDING γ-SPECTROGRAPH. Kao-pin Kuo. Hua Hsueh Tung Pao, No. 1, 48: 60-78(1960).

Gamma spectrographs having high identification capabilities, are widely used for measuring γ rays in radiation chemistry. Comments on the manufacture of the automatic recording γ spectrographs are made. The spectrograph consists of a head, linear impulse amplifier, single channel micro impulse analyzer, timer, automatic adjusting device, dial, integrator, automatic recording device, and counting tubes. When γ rays touch crystals, the crystals transform energy into photo-energy which, in turn, reflects it to the photo cathode which is part of the photomultiplier. The multiplier is used for recording photons from fluorescent substances and amplifying purposes, one flash will amplify to $10^6 - 10^9$. The amplified impulse is then transmitted to a linear impulse amplifier and impulse analyzer. After being checked by automatic adjusting devices, the impulse is transformed into electric potential and by the means of a dial is sent to an automatic recorder. Time intervals are adjusted by a transmitter and data recorded by counting tubes. (auth)

1973 ON THE PROCESSING OF NUCLEAR EMULSIONS. O. N. Kaul (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 35: 459-64(Sept. 1961).

An account is given of a comparative study of the various processing formulas used during the course of emulsion work, using both thick and thin plates. Modified formulas for various processing stages found to give the best results are suggested. The penetration time needed for various developers both in the case of presoaked and non-presoaked emulsions of various thicknesses is given, and also an account of the study of shrinkage factor in nuclear emulsions. (auth)

1974 TRANSACTIONS OF THE JOINT NUCLEAR INSTRUMENTATION SYMPOSIUM, HELD AT NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA, SEPTEMBER 6-8. 1961. IRE Trans. on Nuclear Sci., NS-8: No. 4, 1-164(Oct. 1961).

Twenty-five papers are included in the proceedings. No abstract was prepared on the paper entitled "Survey of Nuclear Space Instrumentation," and the paper "Instrumentation for Use with BEV Accelerators" was previously abstracted. The remaining twenty-three papers are abstracted. (P.C.H.)

1975 REACTOR POWER MONITOR UTILIZING CERENKOV RADIATION. James L. Lovvorn (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 3-5(Oct. 1961).

Cherenkov light in the central region of a water-moderated reactor was measured as a function of reactor power. Simple photovoltaic light detectors were used with a recording microammeter. The electrical current responded to a power increment increase with an initial rise proportional to the reactor power. This was followed by an additional increase in current of from 4 to 5% with a time constant of approximately 4 minutes. (auth)

1976 HIGH-CURRENT REGULATED SUPPLY, COMBINING TRANSISTORS AND MAGNETIC AMPLIFIERS FOR THE OAK RIDGE ISOCHRONOUS CYCLOTRON. B. C. Behr, W. E. Lingar, and W. H. White, Jr. (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 6-9(Oct. 1961).

Circuits are shown and design criteria given for a current-regulated power supply which is typical of 19 supplies of four types built for the Oak Ridge Isochronous Cyclotron. These supplies range from 6.25 to 34 kw with current ratings from 250 to 1200 amp. Current regulation and ripple of 1 part in 10^4 are obtained by separate ac and dc feedback circuits driving a bank of parallel power transistors in series with the load. The dissipation of the transistor bank is limited by a third feedback circuit, which drives a saturable reactor in the power supply to maintain a constant voltage across the transistor bank. The output can be varied from zero to maximum by setting a reference potentiometer which is supplied by a Zener reference with a low temperature coefficient. Plug-in circuits in the feedback networks allow versatility; any regulator can be used with a wide variety of magnets of varying time constants. A modular transistor bank simplifies construction and maintenance. (auth)

1977 LOW LEVEL ALPHA COUNTING WITH SOLID STATE DETECTORS. L. Cathey (E. I. du Pont de Nemours & Co., Aiken, S. C.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 10-15(Oct. 1961).

Two instruments are described that utilize the high discrimination of solid state alpha detectors against beta and gamma radiation. An alpha particle survey meter was developed with a 6 cm^2 sensitive area. It will detect alpha particles in the presence of a 50 r/hr gamma ray field. A low level alpha counter was built with a background of less than 0.001 count per minute. It is useful for measurement of alpha emission from bio-assay samples. (auth)

1978 A SUB-MILLIMICROAMPERE CURRENT AMPLIFIER UTILIZING AN UNUSUAL TRANSISTOR EFFECT. F. T. May and R. A. Dandl (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Soc., NS-8: No. 4, 16-20(Oct. 1961).

Due to a very unusual effect that occurred when certain transistors were operated at low current levels, a direct coupled, transistorized, current amplifier was developed with sensitivity extending below the millimicroampere region of input currents. This amplifier was necessary for the measurement of certain characteristics of the experimental controlled fusion machine, DCX (Direct Current Experiment). Characteristics of the high-gain transistors are presented along with a description of the design and resulting characteristics of a current amplifier with sensitivities of $1/10^{-8}$, $1/10^{-9}$, and $1/10^{-10}$ volt/amp. A possible explanation of the high-gain effect involving the existence of an N-type inversion layer on the P-type base of the silicon transistors is given. (auth)

1979 GAMMA-RAY ASTRONOMY IN SPACE IN THE 50-KEV TO 3-MEV REGION. L. E. Peterson and R. L. Howard (Univ. of Minnesota, Minneapolis). IRE Trans. on Nuclear Sci., NS-8: No. 4, 21-9(Oct. 1961).

A detection system is described which will allow the measurement of considerably weaker primary fluxes than previous experiments. The apparatus is to be placed on a low-altitude, low-latitude earth satellite. A scintillation counter with a shielding collimator is used in the 50-150 kev energy region. In the 0.3 to 3.0 Mev region, the high particle flux requires the use of an anticoincidence shield around the scintillation counter. A Compton coincidence telescope provides directional collimation in this energy region. Data from the detectors are entered into a temporary binary storage and are read out, together with identification and satellite orientation information, to the payload telemetry system at a one bit/sec rate. The entire apparatus weighs 30 pounds, has a complement of 400 transistors, and operates on 650 mw of power. (auth)

1980 THE UNIVERSITY OF CHICAGO MEASUREMENT IN SPACE OF COSMIC RAYS AT ENERGIES ABOVE 0.5 MEV. J. E. Lamport and L. J. Petraitis (Univ. of Chicago). IRE Trans. on Nuclear Sci., NS-8: No. 4, 30-3 (Oct. 1961).

The three-fold coincidence telescope is a compact, flexible instrument providing cosmic-ray measurements related to the charged-particle flux at a well-defined low-energy cutoff. The output to the space-crafts data-handling system may be in either analog or digital form. The experimental results to date provided useful information of the space environment at distances from 200 miles to some 22 million miles from earth. (auth)

1981 ELECTRONIC INSTRUMENTS AND TECHNIQUES FOR PLASMA PHYSICS RESEARCH IN THE UNITED KINGDOM. A. B. Gillespie (Atomic Energy Research Establishment, Harwell, Berks, Eng.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 40-50(Oct. 1961).

Electronic instruments and techniques which were developed and used in support of the U.K. plasma physics research program are described. These generally fall under the headings of machine design, machine control and instrumentation, and plasma diagnostics. To date, most work has been in the latter category which involves a wide variety of measurements ranging from the low frequency end of the spectrum to high energy nuclear radiations. Many of the diagnostic instruments described were developed for use with ZETA, the large toroidal discharge experiment at the AERE, Harwell. (auth)

1982 DANGERS IN SAFETY SYSTEMS. E. P. Epler (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 51-5(Oct. 1961).

The role of the reactor safety is illustrated in relation to accidents. Examples are drawn from the record, from recollection of events, or postulates of events which may reasonably be expected to occur. Failures of safety systems are treated in three categories: safety rods; instruments, sensors, and amplifiers; and systematic failures. (P.C.H.)

1983 A SURVEY OF PLASMA INSTRUMENTATION. Charles B. Wharton (Univ. of California, Livermore). IRE Trans. on Nuclear Sci., NS-8: No. 4, 56-70(Oct. 1961). (UCRL-6521-T)

A survey and evaluation of several diagnostic techniques is given. Applications of some of the more important ones to specific experiments are shown and a comparison of measured quantities is made. A tabulation of several commonly used techniques is given, together with a crude evaluation of them. Most of the methods are applicable to general plasma work but some are used only in controlled fusion experimentation. (auth)

1984 DIAGNOSTIC TECHNIQUES OF THE HIGH COMPRESSION AND NEUTRAL INJECTION EXPERIMENTS. William F. Cummins (Univ. of California, Livermore). IRE Trans. on Nuclear Sci., NS-8: No. 4, 71-6 (Oct. 1961). (UCRL-6492-T)

Investigations were made to determine the energy and spatial distribution of the plasma components, ions and electrons, from the time of their initial injection into the machine through the heating and containment cycle in the Multi-stage compression experiment (Toy Top III). An ion analyzer, consisting of a magnetic momentum analyzer followed by an electrostatic analyzer, was valuable in finding the energy distribution of the plasma ions. The density distribution of the plasma in the experiment's magnetic field was largely determined with electrostatic extraction probes and microwave radiometers and double probes were utilized to find electron temperatures. Li^6 (Eu) and plastic scintillation counters assess the total number and rate of production of neutrons from D-D reactions, which may be confirmed with nuclear emulsions. Electron temperatures in the Single-Stage High Compression Experiment (Table Top II) were determined from an analysis of the escaping electron flux. A magnetically shielded, nude Bayard-Alpert gage determines the total initial gas pressure, the partial pressure of each atomic specie being found with a mass spectrograph. A copper target calorimeter indicates beam current; while neutral particle detectors on the chamber walls and screened Faraday collectors outside of the mirrors show the buildup and loss of plasma. These instruments, along with electrostatic probes, give the density of the plasma at various points in the system. (auth)

1985 DCX-1 INSTRUMENTATION. Herman Postma (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 77-80(Oct. 1961).

The diagnostic techniques that were employed in DCX-1 to study stability of the plasma accumulated in this device are described. These include studies of the radiation emitted by this plasma, the plasma density, the plasma potential, and the energy spectra of the particles ejected from the plasma. Experimental measurements are given to illustrate results obtained using these techniques. (auth)

1986 SOFT X-RAY SPECTROSCOPY OF A HOT PLASMA. F. C. Jahoda (Los Alamos Scientific Lab., N. Mex.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 81-2 (Oct. 1961).

A single crystal x-ray spectrometer was constructed and applied to the study of the x-ray spectrum. The initial measurements of the soft x-ray continuum were made by studying the relative attenuation of several different types and thicknesses of absorber foils. The diffracting element is a beryl crystal of lattice spacing 7.97 A, permitting measurements of the emission spectrum between 5 and 15 A. The energy resolution of the spectrometer over most of its range is determined by the diffraction pattern of the crystal and is 1000 at 10 A. The plastic scintillator photomultiplier detector gives a time resolved record of the emission intensity during the 0.8 sec emission interval. The one electron hydrogen-like spectrum of seven times ionized oxygen (O VIII) and the two electron helium-like spectra of Na X, Mg XI, and Al XII are well developed and easily resolved. (P.C.H.)

1987 A CONTINUOUS PHOTOMETER FOR LOW CONCENTRATIONS OF URANIUM IN ALUMINUM NITRATE-NITRIC ACID SOLUTIONS. E. E. Erickson and C. M. Slansky (Phillips Petroleum Co., Idaho Falls, Idaho). IRE Trans. on Nuclear Sci., NS-8: No. 4, 83-8(Oct. 1961).

An in-line photometer was developed that could detect changes in uranium concentration of about 0.02 grams/liter in the 0-2 gram/liter range; it was set to alarm at a maximum uranium content of 1 gram/liter. The photometer is basically a simple instrument, depending primarily on the use of a photovoltaic cell to compensate for the logarithmic characteristics of light absorption. The sample stream is analyzed in the wave length region of 425 millimicrons, where uranium absorbs light, and the instrument is standardized in the 525 millimicron region, where uranium does not absorb. A Brown amplifier is utilized to adjust the instrument output to the recorder for the reference cycle to zero, so that the recorded output for the measuring cycle is a linear function of uranium concentration. Fail-safe techniques incorporated account for the bulk of the instrument hardware. (auth)

1988 INLINE APPLICATIONS OF GAMMA MONITORING AND URANIUM COLORIMETRY. M. J. Kelly, J. W. Landry, T. S. Mackey, and R. W. Stelzner (Oak Ridge National Lab., Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 89-93(Oct. 1961).

Techniques using gamma scintillation spectrometry and colorimetry for continuous analysis of radiochemical processing plant streams are discussed. The use of a continuous gamma monitor on an organic processing stream is described with emphasis on the practical difficulties encountered. A study substantiated by experiment on an improved gamma monitor is presented. The use of colorimetry to determine uranium concentration in processing streams is considered. Tests and results are reported for a relatively simple colorimeter, and discussion is presented concerning more elaborate techniques. (auth)

1989 FORMULATION AND IMPLEMENTATION OF CRITICALITY CONTROL. A. H. Dexter and J. N. Wilson (E. I. du Pont de Nemours & Co., Aiken, S. C.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 94-100(Oct. 1961).

A program to control the behavior of personnel during a criticality incident was put into effect at Savannah River Laboratory. The objectives are to minimize exposure to radiation and its effects by prompt evacuation and by speedy identification of those individuals who received the highest doses. The many considerations that had to be taken into account in the formulation of the basic philosophy, the specifications of the necessary alarm and dosimetry systems, and the implementation of the program are described in detail. (auth)

1990 FAILSAFE AC HI-LO LIMIT DETECTOR. E. Bianchi and P. Lenk (General Dynamics/Electronics, Rochester, N. Y.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 101-3(Oct. 1961).

A very accurate alternating current limit detector is presented. Its design philosophy, specially suited for multi-channel applications is based on dynamic monitoring of both limits through the same channel. Completely solid-state, this limit detector exhibits an accuracy of ± 0.1% over a temperature range from 0 to 45°C. The design is inherently failsafe; and reliability evaluations were performed for a 1000 channel application. Design philosophy, circuit diagrams, and system operation are presented in detail and discussed. (auth)

1991 A FAST RESPONSE MONITOR FOR AIRBORNE URANIUM DUST. William O. Gentry and Garland B. Seaborn (Oak Ridge Gaseous Diffusion Plant, Tenn.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 104-9(Oct. 1961).

A fixed filter paper alpha air monitor was developed which will sound an alarm within 15 minutes for a uranium dust in air concentration of 6 picocuries per cubic foot. The cause and effect of background variations are discussed. Typical natural background data accumulated over a six months period are included. A prototype instrument was built and operated satisfactorily. The final model of the instrument which is in the design stage will be housed in a cabinet 13 inches high, 15 inches deep, and $21\frac{1}{2}$ inches wide. Pictorial and schematic diagrams are included. (auth)

1992 EFFECT OF THERMAL NEUTRON IRRADIATION ON THERMOCOUPLES AND RESISTANCE THERMOMETERS. C. W. Ross (Leeds and Northrup Co., Philadelphia). IRE Trans. on Nuclear Sci., NS-8: No. 4, 110-18(Oct. 1961).

Certain conditions under which transmutation of elements can result in a temperature measurement error that is reasonably predictable are demonstrated. Methods are developed for estimating the errors for the purpose of: engineering judgment in selecting temperature measuring elements for application; obtaining the order of magnitude for expected error in nuclear applications; and use as a guide in the evaluation of results from nuclear irradiation studies. Theoretical and experimental results show that the thermal emf of a Pt vs Pt-10% Rh is decreased (a temperature reading will be too low) when exposed to high neutron fluxes. The experimental results, together with theoretical considerations, indicate that the changes are due primarily to the transmutation of rhodium. The results are believed to be sufficiently conclusive to permit an estimation of errors to be expected due to transmutations caused by nuclear reactions in this thermocouple. The copper resistance thermometer will suffer a change in resistance due to transmutations of about ten times that for platinum. Even though the change in platinum may be about six times that of nickel-constantan, it may still be selected over nickel in nuclear environments due to non-nuclear considerations, stability and ability to be used at higher temperatures. Transmutations cause an increase in resistance, and therefore, the temperature measured is too high. This is in the safe direction for nuclear applications. (auth)

1993 DIGITAL COMPUTERS IN NUCLEAR POWER APPLICATIONS. J. Pardes and Y. Panis (Compagnie Europeenne d'Automatisme Electronique, Paris). IRE Trans. on Nuclear Sci., NS-8: No. 4, 119-26(Oct. 1961).

The application of digital computers for monitoring radioactivity is discussed, and an existing installation is described. (auth)

1994 FACTORS AFFECTING DESIGN AND SALE OF TRANSISTORIZED INSTRUMENTATION. E. B. Hubbard (General Electric Co., San Jose, Calif.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 127-9(Oct. 1961).

It is concluded that all solid state systems are not necessarily the best for reactor control instrumentation. However, market requirements dictate that the growing preference for solid state systems outweighs all other considerations. (auth)

1995 NUCLEAR PROTECTIVE SYSTEM DESIGN FOR RELIABILITY. V. S. Uderkoffler, J. L. Cockrell, and J. H. Magee (Leeds and Northrup Co., North Wales, Penna.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 130-48(Oct. 1961).

With respect to three developments (the widespread use of solid state components as active circuit elements, the acknowledgment that the electronic protective system problem was a switching circuit and logic design problem, and the desire to reduce the probability of reactor shutdown to instrument failures and introduce the two of three coincidence or majority decision concept) system design concepts for reliability enhancement are provided, and system building blocks for a practical realization of these concepts are presented. Although the ideas presented are pointed toward nuclear reactor protective systems, it is felt that the same approaches can be applied to general systems design. (P.C.H.)

1996 USE OF ELECTROSTATIC PROBES IN PLASMA PHYSICS. Francis F. Chen (Princeton Univ., N. J.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 150-4(Oct. 1961).

The principles of classical Langmuir probe theory are outlined to indicate the type of information theoretically obtainable by this technique. In the dense, hot plasmas and high magnetic fields encountered in modern plasma physics, difficulties arise both in instrumentation and in interpretation of the measurements. Because of these difficulties, perhaps the usefulness of probes lies primarily in the measurements of local fluctuating electric fields. The types of circuits required in probe work are described in general terms. (auth)

1997 OUR CHANGING VIEWS ON REACTOR INSTRUMENTATION. C. G. Lennox and A. Pearson (Atomic Energy of Canada Ltd., Chalk River, Ont.). IRE Trans. on Nuclear Sci., NS-8: No. 4, 155-64(Oct. 1961).

Experience with the three-channel systems on the NRX and NRU reactors is given, along with some comments on the problems that have arisen. A semiconductor current amplifier, an alarm circuit, and a logarithmic amplifier are described and provide examples of instruments that meet new design requirements. Application of solid-state digital techniques to reactor instrumentation becomes attractive when large numbers of signals have to be examined in detail. A semiconductor system is described that is capable of scanning several hundred low-level signals in less than 0.1 sec. The switching circuits used are shown, and the application of these systems to plant monitoring and control is outlined. (auth)

1998 X-RAY STRAIN MEASUREMENT TECHNIQUES FOR CERAMIC BODIES. Leonard N. Grossman and Richard M. Fulrath (Univ. of California, Berkeley). J. Am. Ceram. Soc., 44: 567-71(Nov. 1961).

X-ray diffractometer techniques for measuring triaxial and biaxial strain in ceramic bodies are described. The results of the techniques as applied to model ceramic systems using Al_2O_3 and ThO_2 crystal phases compacted with various glasses in the system $Na_2O-B_2O_3-SiO_2$ are presented. It is shown that internal stresses due to expansion coefficient mismatches occur in these systems and that their magnitudes often exceed the bulk strength of the body. Further applications of the techniques are discussed. (auth)

1999 REMARKS ON THE UTILIZATION OF POWDERS IN NUCLEAR EMULSIONS. Cao xuan Chuan and Nguyên bich Nhu (Office de l'Énergie Atomique, Saigon, Vietnam). J. phys. radium, 22: 459-62(July 1961). (In French)

One of the more recent techniques in the study of nuclear reactions with nuclear emulsions consists in the incorporation of powders of the material to be studied between two emulsion layers and the observation of the resulting disintegration stars. One of the difficulties of this method is that the origin of these decays is not seen. In effect, the charged particles resulting leave observable traces only when they leave the grain. A theoretical estimation is made of the importance of this phenomenon, and the necessary corrections in the final statistics are shown. (J.S.R.)

2000 THE DEVELOPMENT OF A PRECISION TEMPERATURE REGULATOR FOR USE BELOW ROOM TEMPERATURES. J. Gasnier (Centre d'Etudes Nucleaires, Grenoble, France). J. phys. radium, 22: Suppl. to No. 2, 13A-16A(Feb. 1961). (CEA-1988) (In French)

To allow the study of magnetic after-effect between −50°C and room temperature, the temperature of a cavity with an accuracy of ± 2/1000°C was stabilized. This accuracy was achieved by adding to the regular feedback loop a second loop to take care of the slow drift. The apparatus is entirely automatic and battery powered. However, it can be used for experiments lasting no longer than 48 hours. (auth)

2001 HELIUM DISCHARGE CHAMBER. Shūji Fukui, Satio Hayakawa, Ryoichi Kajikawa, and Ken Kikuchi (Nagoya Univ., Japan). J. Phys. Soc. Japan, 16: 2069-70(Oct. 1961). (In English)

A discharge chamber filled with helium gas at atmospheric pressure was used to study proton-α scattering and proton polarization. Tests were made using proton beams from cyclotrons. Results are represented photographically. (L.N.N.)

2002 MEASUREMENT OF THE FIGURE OF MERIT OF A THERMOELECTRIC MATERIAL. A. E. Bowley, L. E. J. Cowles, G. J. Williams, and H. J. Goldsmid (General Electric Co. Ltd., Wembley, Middx., Eng.). J. Sci. Instr., 38: 433-5(Nov. 1961).

An apparatus is described for measuring the three parameters involved in the figure of merit of a thermoelectric material. This apparatus uses only direct current and is based on Harman's technique, in which a temperature gradient is established by means of the Peltier effect. It is demonstrated that the corrections for radiative heat transfer take a relatively simple form at room temperature. It is also shown that the figure of merit of a thermoelectric material can be obtained by measuring the maximum lowering of temperature using the Peltier effect in a junction between the sample under test and a metal. (auth)

2003 PHYSICS AND TECHNOLOGY OF MASS SPECTROSCOPIC ANALYSIS. PART V. Hans Voshage (Max-Planck-Institut für Chemie, Mainz). Kerntechnik, 3: 440-5 (Oct. 1961). (In German)

The methods applied in mass spectroscopy for the measurement of ion currents are discussed. The increasingly applied pre-amplification of very small ion currents in secondary electron amplifiers is treated in very great detail. (auth)

2004 SCINTIGRAPH. A. Stefanovich (Warsaw Medical Academy). Med. Radiol., 6: No. 10, 74-6(Oct. 1961). (In Russian)

A short description is given of an apparatus used to investigate the localization of radioactive isotopes in the human body. (auth)

2005 TRITIUM COUNTING WITH A WINDOWLESS GAS FLOW COUNTER. S. Mizuno, H. Takahashi, and B. Maruo (Tokyo Univ.). Nippon Nogei Kagaku Kaishi, 34: 976-7(1960).

The radioactivity of H^3-compounds was measured at infinite thickness by using a filter paper disc. The tritiated sample was put on a filter paper disc (1.9 cm diameter), which was dried under an infrared lamp, placed in the center of an iron planchet (5 sq cm), and counted with a windowless gas flow counter. Using this paper disc method good proportionality between the total radioactivity of added H^3-adenosine (0−1.0 mg/sq cm), < 0.3 ml/disc) and the actual count was demonstrated. Counting error was within ± 10% at an efficiency of about 0.3% of the total disintegrations. (Abstr. Japan Med., 1: No. 12, 1961)

2006 A MULTI-STABLE STATE CIRCUIT USING TUNNEL DIODES. Y. Hazoni (Centre d'Etudes Nucleaires, Saclay, France). Nuclear Instr. & Methods, 10: 229-30 (1961). (CEA-1735). (In French)

A four stable states circuit was realized utilizing tunnel diodes. The time needed for a change of state is of the order of 10^{-8} s. Thus, the circuit could serve as a fast prememory for a classical multichannel analyser being able to count recurrent pulses having repetition rate up to 40 Mc; it could also serve as the basic unit for the address scaler associated with such analyzers. (auth)

2007 MEASUREMENT OF LOW-ENERGY BETA-RAY SPECTRA USING A HIGH-PRESSURE PROPORTIONAL COUNTER. Paul E. Shearin and Robert L. Hoover (Univ. of North Carolina, Chapel Hill, N. C.). Phil. Mag. (8), 6: 987-95(Aug. 1961).

In order to eliminate self-absorption in solid and liquid sources in the study of low-energy beta-particle emitters, radioactive gas is introduced in a proportional counter. The low-energy spectrum of C^{14} is measured and the data agree with the theoretical plot from 0.5 kev to 7 kev within statistical limits. The cathode of the counter is made of wires and is surrounded by a ring of nine anti-coincidence guard counters. The main-counter anode is unequally divided to minimize end effects. (auth)

2008 THE MANCHESTER HIGH ENERGY MAGNETIC COSMIC RAY SPECTROGRAPH. J. E. R. Holmes, B. G. Owen, and A. L. Rodgers (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 78: 496-504(Oct. 1, 1961).

Modifications to the Manchester counter spectrograph are described which permit momentum measurements on single cosmic particles to a maximum detectable momentum of 1000 Bev/c. The measured output of the instrument was 20 particles per day of which approximately 50% had momentum exceeding 10 Bev/c and 2% exceeding 100 Bev/c. (auth)

2009 ON THE DISCHARGE MECHANISM OF PHILIPS IONIZATION GAUGE (P.I.G.). [PART] II. Nobukazu Miyagawa. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 138-43(Sept. 1961). (In English)

Measurement of the frequency of oscillation accompanying the P.I.G. discharge leads to the following presumptions: There are two factors which play leading roles in sustaining the P.I.G. discharge. These may generally act in combination for the discharge. According as the impressed magnetic field is smaller or larger than critical, the one or the other is predominating. The first factor is related to the B-K oscillation of the electrons and the secondary electrons emitted from the cathodes. The second factor is effective similarly as in the B-type oscillation of magnetron; this is more essential for the P.I.G. discharge. (auth)

2010 ON THE DISCHARGE MECHANISM OF PHILIPS IONIZATION GAUGE (P.I.G.). [PART] III. Nobukazu Miyagawa. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 144-7(Sept. 1961). (In English)

Behavior of the internal anode type P.I.G. whose anode lies inside of the discharge region is reported. According to a similar idea to the one already reported concerning the ordinary P.I.G., it is expectable under a certain condition, one or more electron clusters are formed, and they rotate around the axis with such an angular velocity that can be determined only by the impressed magnetic field and the potential difference between the electrodes for a given P.I.G. Judging from the angular velocity calculated under this idea, it is presumed that the oscillation frequency accompanying the P.I.G. discharge should decrease as the impressed magnetic field increases under a constant potential difference between the electrodes. This point was confirmed experimentally. (auth)

2011 IMPROVEMENTS IN COMBINED PRECIPITATION CHAMBER AND COUNTER UNITS. Frank Harlen, Daniel James O'Sullivan, and Dennis Ernest Lambeth (to Dowty Nucleonics Ltd.). British Patent 876,481. Sept. 6, 1961.

An apparatus for the precipitation and counting of charged particles from gases is designed with provision for rapid replacement of the wire conductor. In operation, the gas is supplied to the precipitation chamber for a short time while charged particles are deposited on the endless wire loop. The wire portion that was in the chamber is then moved into the scintillation counter for counting. Eventually, the wire will break or fray, and a jig with drums or pulleys is provided which will hold a replacement wire loop and transfer it into the operative position. (D.L.C.)

2012 IMPROVEMENTS IN AND RELATING TO THERMOCOUPLES. Leslie Bernard Hunt and Henry Connor (to Johnson, Matthey and Co. Ltd.). British Patent 876,553. Sept. 6, 1961.

A thermocouple suitable for use at high temperatures and under neutron irradiation conditions such as in reactors may be fabricated using two Pt—Mo alloys, one containing 3 to 6 wt.% Mo and the other 0.01 to 1 wt.% Mo. The resulting Pt—Mo/Pt—Mo thermocouple has a lower neutron capture cross section than a Pt/Pt—Rh thermocouple, but it is not as oxidation-resistant and hence should be used in a neutral or reducing atmosphere. (D.L.C.)

2013 IMPROVEMENTS IN OR RELATING TO MEASURING APPARATUS. Frank Peter Ellen and Geoffrey Leet (to United Kingdom Atomic Energy Authority). British Patent 881,620. Nov. 8, 1961.

An apparatus is designed for measuring dimensional changes of remote objects, e.g., within a reactor. The apparatus comprises a plunger-operated rotary micrometer gage, a rotary position transmitter, and fluid pressure-actuated means for advancing and retracting the plunger. (D.L.C.)

2014 IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONNECTORS. Andre Barthelemy and Victor Gerard (to Commissariat a l'Energie Atomique). British Patent 881,886. Nov. 8, 1961.

An electrical connector is designed for making a large number of electrical connections between a moving object and a fixed holder accurately and remotely, such as in the presence of intense radiation. The connector comprises a holder containing a socket and a tubular member, with stud pluralities carried by both socket and tubular member. In operation, the socket is inserted into the tubular member by locating bevelled edges and the studs connected. (D.L.C.)

Materials Testing

2015 (ORNL-3139) SURFACE PREPARATION OF METALLOGRAPHIC SPECIMENS OF ZIRCONIUM-BASE ALLOYS CONTAINING COPPER. J. E. Spruiell and D. M. Hewette, II (Oak Ridge National Lab., Tenn.). Oct. 27, 1961. Contract W-7405-eng-26. 10p.

A combination of chemical and electrolytic polishing was successful in the metallographic preparation of Zr—1% Cu and Zr—1.6% Cu alloys. Chemical polishing produced flat surfaces that were suitable for examination with polarized light but were not suitable for examination with bright-field illumination. Electrolytic polishing applied to ground or mechanically polished specimens produced surfaces that were well etched but often were pitted heavily. A chemical polish followed by a short electrolytic polish produced microstructures suitable for examination with both bright-field and polarized light at high or low magnifications. (auth)

2016 APPLICATION OF NON-DESTRUCTIVE METHODS FOR THE DETECTOSCOPY OF FUEL ELEMENTS. G. Ondracek. Kerntechnik, 3: 446-52(Oct. 1961). (In German)

Due to the great variety of structures and characteristics of fuel elements, it is impossible to state standard test methods which could be applied universally, that is, independently from the type of fuel element. First of all, there are significant differences in the shape of fuel elements. Their cross section may be round, square, or rectangular. Therefrom, the plate element is derived in cases of rectangular cross section and great width. Furthermore, sphere-shaped fuel elements are made. The mechanical, thermal, ultra-acoustical, ultra-optical, and electromagnetical procedures are described. (auth)

2017 A MAGNETIC TESTER FOR THE MEASUREMENT OF INTERLAYER AIR-GAPS BETWEEN STEEL REINFORCING BANDS OF PRESSURE VESSELS. J. W. Walley (A.E.I., Manchester, Eng.). Metallurgia, 64: No. 384, 165-75(Oct. 1961).

A new non-destructive testing device is described that is designed to give magnetically an approximate indication of the air-gap length between ¼ in. thick steel reinforcing bands used to strengthen a large steel pressure vessel. When a powerful magnet is placed on the near side of a band some magnetic flux passes across the air space on the far side into an adjacent band or shell plate. A change in the air-gap length varies this flux, which in turn affects the main flux passing through the test zone. The change in main flux is then shown as a change in the external field strength between the magnet poles on a moving magnet magnetometer. The tester reads average gap directly from 0 to 0.060 in. to within about ±20% provided certain test conditions obtain. The tester is simple and portable, requires no special skill to operate and is independent of electrical supplies. (auth)

2018 IMPROVEMENTS IN OR RELATING TO ULTRASONIC INSPECTION APPARATUS. Raymond Ford Hanstock, Norman Frank Godwin, Russell Frank Lumb, and Michael Alan Williams (to United Kingdom Atomic Energy Authority). British Patent 883,173. Nov. 22, 1961.

An ultrasonic inspection apparatus for weld joints of tubular bodies is designed which does not incur difficulties due to cable twist and which can be used to inspect a weld joint whose plane is oblique to the axis of the tubular body. The apparatus comprises a non-rotatable ultrasonic test probe insertable within the body, a rotatable reflector for reflecting ultrasonic signals from the probe toward a weld joint, and means for rotating the reflector to inspect the weld joint in a sequence of peripheral scans. Means also provided to cause the scan to follow an oblique path in inspecting oblique weld joints. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

2019 (NP-10937) A LABORATORY STUDY OF GAMMA-RAY SPECTRA AT THE SURFACE OF ROCKS. A. F. Gregory (Geological Survey of Canada, Ottawa) and J. L. Horwood (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Apr. 1961. 56p. (R-85)

A 100-channel gamma spectrometer was used to investigate the changes in gamma spectra resulting from variations in the thickness of radioactive mineral sources. Uranium, thorium, and potassium were studied separately in the form of prepared mineral aggregates and together in the form of large rock specimens. Rocks are shown to have distinctive gamma spectra that reflect their radioelement content. For common rocks, the intensity of gamma radiation from potassium predominates over that from either uranium or thorium and may exceed their sum. (auth)

2020 (TEI-784) GEOLOGIC ASPECTS OF THE NOVEMBER 1960 HIGH-EXPLOSIVE TEST AT THE PROJECT CHARIOT SITE, NORTHWESTERN ALASKA. Reuben Kachadoorian (Geological Survey, Washington, D. C.). May 1961. 14p.

In November 1960, a 256-pound high explosive cratering experiment was conducted at the Chariot test site, northwestern Alaska. The explosive was detonated at a depth of 8.7 feet in steeply dipping thinly bedded mudstone of the Tiglukpuk(?) Formation of Late Jurassic age. The mudstone was frozen to a depth of 1.5 feet, thawed between 1.5 and 4.0 feet below the surface, and permanently frozen below 4.0 feet from the surface. A symmetrical crater 8 feet deep and 26 feet in diameter was produced. An asymmetrical apron of ejected debris was deposited within a 550-foot radius around ground zero. Three zones of debris were recognized: (1) an inner zone, closest to ground zero, composed of very coarse debris derived from the upper frozen zone, (2) an intermediate zone composed of fine debris derived from the thawed zone, and (3) an outer zone composed of coarse debris derived from the thicker beds of the permanently frozen zone. In addition, a very fine grained tonguelike sheet of fallout debris was mapped. The spatial distribution of the debris was controlled by the proximity of the parent material to the explosive. Debris derived from close to the center of the explosive was thrown the greatest distance from the crater. Debris fragment size was controlled by the cementation of the mudstone by ice and proximity to the center of the explosion. Debris derived from unfrozen zones was fine, in contrast with coarse debris derived from frozen zones. Debris from the permafrost zone close to the center of the explosion was finer than debris from the frozen zone near the surface. Asymmetry of the debris apron was probably controlled by the attitude of the mudstone. Fallout distribution was controlled by the wind direction. The cloud resulting from the detonation was about 190 to 200 feet in average height and was about 175 feet wide. However, in the center of the cloud, a streamer about 30 feet wide rose to a height of about 250 feet. This streamer of cloud debris probably marks the trajectory of the concrete stemming that was thrown out 335 feet south of ground zero. (auth)

2021 (UCRL-6189) THE "NEAR" MAGNETIC INDUCTION SIGNAL FROM A NUCLEAR EXPLOSION DUE TO MOVEMENT OF THE EARTH'S MAGNETIC FIELD. Stirling A. Colgate (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1960. Contract W-7405-eng-48. 8p.

The "near" magnetic induction signal from a nuclear explosion in the earth's atmosphere due to movement of the earth's magnetic field is predicated upon the entrapment of the earth's magnetic flux in the air surrounding the bomb. The entrapment of the flux is due to the initial conductivity of the ionization created by gamma rays. The subsequent movement of the magnetic flux is determined by the hydrodynamics of the expanding fireball so that a spherical hole is blown in the magnetic field distorting the lines of force. Slow magnetic field changes of up to 10 gauss occur during 1 second due to the bending of the earth's lines. (auth)

2022 (UCRL-13020) SOURCES OF INFORMATION ON ROCK PHYSICS. CURRENT LITERATURE, AUGUST 1961. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Aug. 30, 1961. For Univ. of California. Lawrence Radiation Lab., Livermore. Contract W-7405-Eng-48. 51p.

A current literature review on rock physics, rock mechanics, wave propagation, and other related subjects is presented. The 199 references are arranged alphabetically by author. (M.C.G.)

2023 (UCRL-Trans-738) RADIOACTIVITY IN THE ATMOSPHERE. THE PERCENTAGE OF SMALL AND LARGE RADIOACTIVE IONS IN THE AIR. Jean Bricard, Jacques Pradel, and André Renoux. Translated by Thomas E. Knatt (Univ. of California Lawrence Radiation Lab., Berkeley) from Compt. rend., 252: 2119-21(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 19644.

2024 RADIOACTIVITY OF THE PUYS RANGE LAVAS. M. Goldsztein and S. Guillermo (Commissariat à l'Energie Atomique, Fontenay-aux-Roses, France). Bull. soc. Franç. minéral. et crist., 84: 6-8(1961). (CEA-1696). (In French)

A general survey was made on the distribution of radioactivity and of uranium in the French igneous rocks. The lavas from the Puys range of mountains form a perfectly continuous magmatic differentiation system which makes it possible to follow the distribution of the radioactivity, of the total uranium, and of the soluble uranium in the rock series whose petrographic and geochemical position is accurately known. Various correlation diagrams are presented. (auth)

2025 DETAILED RADIOMETRIC SURVEYS. ATTEMPTS TO IMPROVE THEIR EFFICIENCY. L. Alliot, J. Bonnet, and J. A. Sarcia. Chronique mines et recherche minière, No. 296, 3-11(Mar. 1961). (CEA-1903). (In French)

In prospecting for uranium ores, radiometric techniques occupy an important place among the various prospecting methods and thus represent an appreciable financial charge. According to the condition of the deposits and the precision required, the systematic investigations can be more or less detailed. γ-ray measurements are usually carried out at the peak of the rigid lattices whose dimensions must be related to those of the defects. Before choosing these dimensions, it is necessary to know which are the smallest radiometric defects liable to be advantageous financially. Therefore, an attempt is made to define the characteristics of these defects. From these, the most suitable research lattice in each case is deduced. An example shows that an appreciable economy can be expected from the study. It is also shown that an important increase in yield can be obtained by adopting a hexagonal body-centered lattice. (auth)

2026 TEST OF THE DATING OF URANIUM MINERALS OF RECENT FORMATION BY AUTORADIOGRAPHY. Francis Chantret. Compt. rend., 253: 500-1(July 17, 1961). (In French)

A principle of dating based on the function $k = f(t)$, ratio of the apparent uranium content obtained by autoradiography to the actual uranium content obtained by chemical methods, is given. The construction of the curve $k = f(t)$ shows that the precision is good up to 250,000 years. The results obtained with a autunite sample from Bois Noirs were in agreement with the age obtained by radiometric determinations. (J.S.R.)

2027 ANALYSIS OF THORIUM TRACES IN SOME FRENCH URANIUM MINERALS. René Coppens, Georges L. Durand, and Kazuhisa Nozawa (Centre de Recherches Radiogeologiques, Nancy). Compt. rend., 253: 884-6 (July 31, 1961). (In French)

A precise and rapid method for the analysis of thorium traces is described. A table of results obtained on some French pitchblendes is given. A more detailed study was made of a "Bois noirs" ore where the thorium appears bound to the uranium in rich minerals but where there is no definite mineral form when the uranium concentration is less than 6%. (tr-auth)

2028 SULPHUR ISOTOPE GEOCHEMISTRY. H. G. Thode (MacMaster Univ., Hamilton, Ont.), J. Monster, and H. B. Dunford. Geochim. et Cosmochim. Acta, 25: 159-74 (Nov. 1961). (In English)

Sulfur isotope abundances of thirty-nine specimens of seventeen meteorites are reported. The results show again the remarkable constancy of the sulfur isotope ratios for meteorites of all types. However, differences in the S^{32}/S^{34} ratios of 0.4% would appear to be significant. The S^{32}/S^{34} ratio for meteorites is discussed as a possible base level from which fractionation in the earth's crust began. The value is compared with estimates of average values found for terrestrial samples including some recent results of igneous intrusives. A large suite of sea water samples collected from widely separated points in three oceans at various depths were also investigated and the S^{32}/S^{34} ratios reported. The results show that the sulfate in the three oceans is exceedingly uniform in isotope ratio, with an enrichment of 20.1% ± 0.3 in S^{34} over that of the meteoritic standard. Sulfur isotope ratios of sulfur in a sea shell, sulfides in shallow ocean sediments, sulfate in rain water and in present-day formation of gypsum evaporites from the sea, were measured and are compared to the sea water level. The geochemical sulfate cycle is discussed in the light of these results. (auth)

2029 ABUNDANCE AND DISTRIBUTION OF ALKALI ELEMENTS IN VICTORIAN AUSTRALITES. S. R. Taylor and M. Sachs (Australian National Univ., Canberra). Geochim. et Cosmochim. Acta, 25: 223-8(Nov. 1961). (In English)

New determinations of Li, Na, K, Rb, and Cs for eight Australites from Victoria average 41 ppm Li, 0.81% Na, 1.76% K, 73 ppm Rb, and 2.1 ppm Cs. These figures are lower than the averages for tektites from localities west of Victoria, and extend the previously described decrease in concentration of the alkali elements from west to east across Australia. The over-all average composition for 24 Australites analyzed here and previously is 42 ppm Li, 0.90% Na, 1.85% K, 81 ppm Rb, and 2.5 ppm Cs (K/Rb = 231). A close coherence exists between all pairs of the alkali elements, similar to the classical K/Rb relationship, and is interpreted as due to a physical mixing of two parent components. The average concentrations of the alkali elements are consistent with derivation from a mixture of 75% shale (less water and CO_2) and 25% SiO_2, with possibly some small selective loss of K, Rb, and Cs during initial melting. (auth)

2030 ISOTOPES OF URANIUM IN NATURAL CONDITIONS. II. ISOTOPIC COMPOSITION OF URANIUM OF MINERALS. V. V. Cherdyntsev, D. P. Orlov, E. A. Isabaev, and V. I. Ivanov (Geological Inst., Academy of Sciences, Moscow and Kazakh State Univ., Alma-Ata). Geokhimiya, No. 10, 840-8(1961). (In Russian)

The deviation of U^{234}/U^{238} from the equilibrium state is in most cases, if not always, connected with the removal of uranium from the mineral, the uranium of solutions and of the minerals precipitated from them proving to be enriched in U^{234}, and the uranium which remained in the mineral being somewhat empoverished in this isotope. An excess of U^{234} is detected in some endogenic minerals. In a number of cases, including such as primary visually preserved minerals, a deficiency in U^{234} is observed. This bears witness of an intensive uranium migration in the zone of epigenesis. A measurable U^{235} excess may accumulate as a result of the decay of some transuranium isotope, being present in the mineral. The surplus content of U^{235} in magnetites of a pegmatite vein by 45 ± 5 and 23 ± 6 percent is confirmed. The other minerals of this ore body have a normal isotopic composition which indicates the local presence of transuranium emitter in the magnetite. An excess of actinium (and U^{234}) is also found in this mineral. An excess of U^{235} of about 40 percent is established in one of the molybdenite samples. A bond between minerals with a surplus of U^{235} and minerals with a surplus actinium is outlined but its character is not found. (auth)

2031 URANIUM IN ROCK MINERALS OF THE INTRUSION OF KYZL-OMPUL MOUNTAINS (NORTH KIRGISIA). L. L. Leonova and L. S. Pogiblova (Vrnadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Geokhimiya, No. 10, 901-6(1961). (In Russian)

The uranium distribution in rock minerals (syenites, granosyenites, and alaskite granites) of the Kyzyl-Ompul massif is studied. Alaskite granites are characterized by the granite type of uranium distribution in minerals, about 50 percent of this element being connected with rockforming and about 50 percent with accessory uranium minerals. In syenites uranium (about 70 percent) is bound to rock-forming minerals. The same minerals from syenites and granites strongly differ by their uranium content and are constant in the ranges of each of those rock types. Granosyenites have an intermediate (between syenites and granites) type of uranium distribution in minerals. (auth)

2032 ALPHA-LEAD AGE OF SOME URALIAN MINERALS. A. A. Krasnobaev (Inst. of Mining and Geology of the Ural Branch of the Academy of Sciences USSR. Sverdlovsk). Geokhimiya, No. 10, 931-6(1961). (In Russian)

The absolute age of the alkaline massif of the Vishnevye and Ilmenskye mountains (282 and 284 million years) of the intrusions of Kochkarsk, Mursino-Alabash, and Karabutak (263, 273 and 293 million years respectively) is determined with the aid of the alpha-lead method. The most suitable minerals (without zircons) for this purpose are monazite, aeshinite, and xenolite. The results agree well with the data obtained with the K-Ar method. (auth)

2033 DISPERSION OF GROUND SPHERICAL VOLUME IN A BLAST CENTER. B. A. Vinogradov, V. N. Rodionov, and E. I. Shemyakin. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 3, 36-42(Sept.-Oct. 1961). (In Russian)

The dispersion of a spherical volume of ground by a blast center was analyzed. The results are adapted in calculating the maximum ground lift in the epicenter during an explosion. (tr-auth)

2034 NIOBIUM (COLUMBIUM) AND TANTALUM, 1960. Preliminary. Review 19. V. B. Schneider. Ottawa, Department of Mines and Technical Surveys, 1961. 7p.

A summary of niobium and tantalum ore deposits in Canada is given. (P.C.H.)

2035 AIRBORNE RADIOACTIVITY AND GEOLOGIC MAP OF THE COASTAL PLAIN AREA, SOUTHEAST TEXAS. R. M. Moxham and D. H. Eargle (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-198. 1961. $0.75(USGS).

2036 GEOLOGIC MAP OF PART OF THE BEAVER QUADRANGLE, UTAH. Eugene Callaghan and Raymond L. Parker (Geological Survey, Washington, D. C.). Mineral Investigations Field Studies Map MF-202. 1961. $0.50 (USGS).

2037 PRELIMINARY STRUCTURE CONTOUR MAP ON TOP OF SALT IN THE PARADOX MEMBER OF THE HERMOSA FORMATION IN THE SALT ANTICLINE REGION, COLORADO AND UTAH. Donald P. Elston and Eugene M. Shoemaker (Geological Survey, Washington, D. C.). Oil and Gas Investigations Map OM 209. 1961. $0.50(USGS).

2038 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE FLORESVILLE SE QUADRANGLE, KARNES AND WILSON COUNTIES, TEXAS. D. H. Eargle, J. V. A. Trumbull, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-246. 1961. $0.50(USGS).

2039 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE STOCKDALE SW QUADRANGLE, KARNES AND WILSON COUNTIES, TEXAS. J. V. A. Trumbull, D. H. Eargle, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-247. 1961. $0.50(USGS).

2040 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE STOCKDALE SE QUADRANGLE, KARNES, DE WITT, AND WILSON COUNTIES, TEXAS. D. H. Eargle, J. V. A. Trumbull, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-248. 1961. $0.50(USGS).

2041 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE FALLS CITY NEW NW QUADRANGLE, ATASCOSA KARNES, AND WILSON COUNTIES, TEXAS. R. D. Brown, Jr., D. H. Eargle, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-249. 1961. $0.50(USGS).

2042 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE FALLS CITY NE QUADRANGLE, KARNES AND WILSON COUNTIES, TEXAS. R. D. Brown, Jr., D. H. Eargle, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-250. 1961. $0.50(USGS).

2043 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE KARNES CITY NW QUADRANGLE, KARNES COUNTY, TEXAS. D. H. Eargle, J. Trumbull, and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-251. 1961. $0.50(USGS).

2044 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE FALLS CITY SW QUADRANGLE, ATASCOSA KARNES, AND LIVE OAK COUNTIES, TEXAS. D. H. Eargle, R. D. Brown, Jr., and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-252. 1961. $0.50(USGS).

2045 PRELIMINARY AERORADIOACTIVITY AND GEOLOGIC MAP OF THE FALLS CITY SE QUADRANGLE, ATASCOSA KARNES, AND LIVE OAK COUNTIES, TEXAS. D. H. Eargle and R. M. Moxham (Geological Survey, Washington, D. C.). Geophysical Investigations Map GP-253. 1961. $0.50(USGS).

2046 ATMOSPHERIC ACTIVITIES AND DATING PROCEDURES. A. G. Maddock and E. H. Willis (Cambridge Univ., Eng.). p.287-335 of "Advances in Inorganic Chemistry and Radiochemistry. Volume 3." New York, Academic Press Inc., 1961.

The radioactive components of the atmosphere are described. The nature, measurement, and factor influencing the emanation content of the atmosphere of radioactive species of terrestrial origin are discussed. Activities generated by cosmic radiation and their mode of formation are reviewed. Methods of measurement of radiocarbon are outlined. The discovery and measurement of tritium are discussed. Artificial activities from various sources are described. (M.C.G.)

2047 URANIUM, 1960. Preliminary. Review 26. J. W. Griffith. Ottawa, Department of Mines and Technical Surveys, 1961. 11p.

A summary of uranium ore deposits in Canada is given. (P.C.H.)

2048 METODY GEOLOGO-GEOFIZICHESKOGO OBSLUZHIVANIYA URANOVYKH RUDNIKOV. (Geological and Geophysical Exploration in Uranium Mines). G. I. Petrov, M. V. Kutenkov, I. M. Tenenbaum, and L. S. Evseeva. Moscow, Atomizdat, 1960. 219p.

Radiometric sampling and rapid analysis of radioactive ores in uranium mines are described. Geological prospecting, evaluation of the ore technology and reserve, and geological control of the exploration and mining of uranium deposits are discussed. 94 references are included. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 1315, 1357, 1989, and 1991

2049 (AD-258943) WEATHER. SOME ENVIRONMENTAL EFFECTS ON TOXIC HAZARDS. (Air Weather Service, Washington, D. C.). May 15, 1961. 36p. (4WGP 105-8-1)

The basis of using meteorological information to predict the dilution and dispersion of foreign materials released into the atmosphere is discussed in detail. The theory and formulas for predicting atmospheric diffusion are given. Nomograms are presented for atmospheric diffusion and related parameter calculations. The results of a hazards study of a plant handling N_2O_4 and N_2H_4 under accident conditions are summarized. (D.L.C.)

2050 (AFCRL-811) METEOROLOGICAL EVALUATION AND APPLICATION OF RAINFALL RADIOACTIVITY DATA. GRD Research Notes No. 65. Per B. Storeboe (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). Aug. 1961. 27p.

The meteorological analysis of weather situations during which radioactive samples were collected is described and the limitations of interpretation are discussed. It is shown that precipitation washes out a significant part of the radioactive particles in the air. Successive samples from weather systems revealed that when precipitation was produced in the warm air mass only, the radioactivity in precipitation decreased with time and was independent of location. To explain this, a new weather system model is proposed in which the main part of the precipitation is produced by uniform lifting of a warm air tongue. (auth)

2051 (APAE-2(Rev.1)(Suppl.1)) HAZARDS REPORT FOR THE BF_3 WITHDRAWAL MECHANISM IN THE SM-1. J. R. Coombe (Alco Products, Inc., Schenectady, N. Y.). Oct. 13, 1961. Contract AT(30-1)-2639. 15p.

A design and operational description is presented of a BF_3 withdrawal mechanism planned for installation on one of the two startup channels at the SM-1. An analysis of possible malfunctions is included. (J.R.D.)

2052 (BLG-60) BR2—THE MAXIMUM CREDIBLE ACCIDENT PROCEDURE AND CONSEQUENCES. G. Penelle (Brussels. Centre d'Etude de l'Energie Nucleaire). May 1961. 72p.

The maximum credible accident is defined as the most serious accident which one can conceive without implying any clearly impossible circumstance. As far as the BR2 is concerned, a step change reactivity insertion of 1.3 to 1.9% would result in a nuclear runaway with the following consequences: a) the fuel elements would be heated beyond the melting point and it is assumed that a temperature as high as 1200°C can be reached; b) at such a temperature, an aluminum-water reaction could occur; and c) chemical reaction would release hydrogen which could react with the oxygen of the air. Furthermore, it is supposed that sodium used for experiments would react with water. The amount of energy produced in all these ways would be released in the containment building, heating its atmosphere. The resulting overpressure would result in fission products escaping through the building walls; these losses are directly related to the behavior of the pressure which is studied taking into account the heat absorption in the materials of the building. The inhaled and deposited quantities of several dangerous isotopes (I, Sr, Cs) are then computed; finally, the integrated dosage of external radiation is given. (auth)

2053 (IA-683) EVALUATION OF ISOTOPE RATIOS IN FALLOUT. J. Gilat (Weizmann Inst. of Science, Rehovoth, Israel and Israel. Atomic Energy Commission, [Rehovoth]). Aug. 1961. 8p.

Thesis submitted to Hebrew Univ., Jerusalem.

An analysis of data on fall-out from nuclear explosions is presented. It appears that useful information on fall-out composition can be obtained from analysis of two isotope ratios in a period in which the number of tests is relatively small, however, the distribution of material from different tests is far from uniform and is subject to large day-to-day variations. The difference between daily results and monthly averages reflects the effect of tropospheric transport and mixing. This aspect of the problem can be analyzed through correlation of the variations in fall-out composition with synoptic observations. (J.R.D.)

2054 (NP-10935) LITHIUM HYDROXIDE CANISTERS FOR PERSONNEL SHELTERS. Final Report. Technical Report No. 151. R. J. Zablodil, J. M. Stephenson, and R. S. Chapler (Naval Civil Engineering Lab., Port Hueneme, Calif.). June 13, 1961. 25p.

A canister-blower device with two lithium hydroxide canisters in parallel was developed to reduce the CO_2 in personnel shelters. Operational instructions are provided, with a chart showing when and how to use the equipment. (auth)

2055 (NP-10964) HAZARDS SUMMARY REPORT FOR A TRIGA-I NUCLEAR REACTOR. (Texas. Univ., Austin). 1961. 100p.

Issued as Texas, Univ., Bur. Eng. Research, Circ. No. 28.

An analysis of the hazards that might arise while operating the Triga-Mark I pulsing reactor is presented. It is noted that the operational safety of the reactor results from an inherent self-regulating characteristic of the core and is supplemented by careful operating procedures. It is concluded that operation of the reactor will cause no undue risk to the health and safety of the staff or of the public. (J.R.D.)

2056 (NP-10982) COMMONWEALTH X-RAY AND RADIUM LABORATORY ANNUAL REPORT FOR THE YEAR ENDED 30th JUNE, 1961. (Australia. Commonwealth X-Ray and Radium Lab., Melbourne). 1961. 30p.

The service and investigational activities of the Commonwealth X-Ray and Radium Laboratory are reported. Radium, radon, x-ray, isotope, radiation, and advisory services are discussed. The work of the radiochemical and low-level measurement facility is described. (M.C.G.)

2057 (ORNL-3189) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT, FOR PERIOD ENDING JULY 31, 1961. (Oak Ridge National Lab., Tenn.). Oct. 31, 1961. Contract W-7405-eng-26. 261p.

Progress is reported in 26 papers on radioactive waste disposal, ecological research, radiation physics and dosimetry, internal dosimetry, and health physics technology. Twenty-five separate abstracts were prepared. One paper was previously abstracted for NSA. (M.C.G.)

2058 (ORNL-3189(p.6-13)) STUDY OF WHITE OAK CREEK DRAINAGE BASIN. T. F. Lomenick, K. E. Cowser, and H. J. Wyrick (Oak Ridge National Lab., Tenn.).

A number of monitoring stations were installed to describe the release of radionuclides to the White Oak Creek drainage basin, and to delineate their accumulation and transport in the physical and chemical environment. The quantity of radionuclides contributed from the laundry and burial ground 4 is small, even though some leaching of buried solid waste by recharging rainfall is evident. Approximately 150,000 ft^3 of contaminated silt was washed from the bed of White Oak Lake since 1953, due primarily to channel erosion. Preliminary analyses of sediment cores from the lake bed showed that most of the gross gamma activity is contained in the upper 12 in. of soil. (auth)

2059 (ORNL-3189(p.13-27)) CLINCH RIVER STUDIES. P. H. Carrigan, E. G. Struxness, et al. (Oak Ridge National Lab., Tenn.).

Water sampling and stream gaging stations and analytical procedures were established to provide information about flow, discharge, stable and radioactive ion concentrations, and sediment load in the Clinch River. A preliminary estimate was made of the radionuclide distribution and accumulation in bottom sediments of the Clinch River from Clinch River Mile (CRM) 21.6 to CRM 4.7. This estimate, based on the results of core samples, collected from 19 cross sections, showed that Cs^{137}, Ru^{106}, Co^{60}, and total rare earths exhibit concentration maxima at CRM 20.8 and CRM 11.0. A comparison of the calculated total activity in the Clinch River with the core-sample estimate shows that approximately 14% (184 curies) of the total activity (1300 curies) is associated with bottom sediments. The estimated amounts of radioactivity in bottom sediments as determined by analysis of the core samples are: Cs^{137} = 99.48 curies; TRE = 37.64 curies; Ru^{106} = 33.20 curies; Co^{60} = 11.64 curies; and Sr^{90} = 1.86 curies. (auth)

2060 (ORNL-3189(p.81-104)) WHITE OAK LAKE BED STUDIES. S. I. Auerbach, D. A. Crossley, Jr., et al. (Oak Ridge National Lab., Tenn.).

Research in White Oak Lake bed and the surrounding contaminated environs takes advantage of the presence of mixed radioisotopes, both as a source of radiation and as a tool for studying the behavior of these radioelements in the environment. During the past two years there was virtually no change in the over-all distribution of plant communities on the ecology study area in the lower section of White Oak Lake bed. The major changes that are developing represent invasion by low-land moist-soil and upland woody vegetation. The former are becoming dominant along the creek shore and the latter in the higher areas adjacent to the original lake shore. Soil-to-plant studies of uptake of radionuclides included an experiment on rate of uptake by Lespedeza during the growing season. There was a fivefold increase in Sr^{90} accumulation during the 1960 growing season which resulted in a total of $(157.0 \pm 9.7) \times 10^3$ (s.e.) $\mu\mu c$ of Sr^{90} per m^2 of vegetation. Based on the total number of days in the growing season this accumulation represented an uptake rate of 1300 ± 81 $\mu\mu c$ of Sr^{90} per m^2 per day. Lespedeza was compared with Polygonum (smartweed) harvested the previous year by using a coefficient of transfer, which is the ratio of the uptake rate to the soil burden per unit area. On this basis Polygonum as a vegetation unit seems to be approximately 4.5 times more effective than Lespedeza in accumulating Sr^{90}. Use of massive doses of phosphate fertilizer showed encouraging results in decreasing the total uptake of Sr^{90} in proportion to increase in total yield. Increases in total radiostrontium were 136, 237, and 266% (in terms of controls) compared to yield increases of 223, 453, and 568%. The rates of elimination of radioisotopes by insects can be used to estimate the rates of feeding. Better estimates of an average λ (the elimination constant) for cesium were the result of analyses of the relationship between weight of insect and rate of elimination. The elimination rate for cesium decreased as size of insect increased, when different insect species were compared. Immature stages had lower rates of elimination than their smaller size would suggest. Estimates of the annual consumption of vegetation by insects were increased from 3 to 5% of annual plant production, by refined estimates of λ. Few cotton rats out of 180 on the lake bed were trapped for periods of over 6 months, and only 1 was present for over a year. The sex ratio of males (178) to females (137) differed significantly from 1:1 for the lake bed, but not for an uncontaminated old field. The average number of young per litter was smaller at the lake bed (5.4) than at the old field (7.7). Weighted incidences of injuries and abnormalities for both areas were about the same. Whole-body dose rates calculated for muskrats from the radioactive settling basin ranged from 15.1 rems/week (contents of GI tract not included) to 112 rems/week (contents of GI tract included). Calculations showed that a person eating 1 lb of muskrat meat would have received a whole-body dose rate of 0.023 rem/week at t = 0, and 0.034 rem/week shortly after ingestion of the second pound of meat one week after the first ingestion. For cotton rats living in an area with an average external radiation field of 15 mr/hr, the integrated whole-body dose rate from internal and external sources was estimated to be 2.6 rems/week; 86% of this dose rate was due to the radiation field above the lake bed, 10% was due to radionuclides in the tissues, and the remaining 4% was due to radioisotopes in the contents of the GI tract. Body burdens of Sr^{90}, Cs^{137}, Ru^{106}, and Co^{60} determined by radioassay of known-age cotton rats were lower than predicted for each isotope. Few gross pathologies were observed in mammals from radioactive and nonradioactive areas, but examination of tissues revealed an unexpected number of generalized pathologies, none of which could be positively related to radiation exposure. (auth)

2061 (ORNL-3189(p.230-2)) STUDIES OF SURFACE CONTAMINATION. G. W. Royster, Jr. (Oak Ridge National Lab., Tenn.).

Attempts to compare radioactive contamination control criteria for different installations led to a study of the methods available for measuring "removable" surface contamination. Thorium dioxide dust, 3 μ in diameter, was allowed to settle onto representative test surfaces and the degree of removability was determined by each of three methods—smears (abrasion), adhesive papers, and a new method employing air impingement to redisperse particles from the surface (the "smair" sample). In general, no one mechanism for particle removal was equivalent to the other methods. Factors variously affecting the fraction removed per sample included size of the area sampled, dustiness, aging the deposit, composition of the surface, and surface roughness. Adhesive paper samples consistently removed the largest fraction of the total contamination. Smear samples were the most variable, while smair sample yield was practically unaffected by any of these factors except the surface composition. (auth)

2062 (TID-5360(Suppl.3)) A SUMMARY OF INDUSTRIAL ACCIDENTS IN USAEC FACILITIES. (Office of Operational Safety and Fire Protection Branch, AEC). 37p.

The accident experience of the AEC contractor operation for 1959 and 1960 is reported. Incidents involving radioactive materials are described. A table of inadvertent criticality was included to supplement other tables. A tabulation of exposure records at values from 0 to 15 r is given. (M.C.G.)

2063 (TID-13648) RESEARCH AND DEVELOPMENT OF PROTECTIVE RESPIRATORY EQUIPMENT. Progress Report, April 1, 1961 to July 1, 1961. Leslie Silverman and William A. Burgess (Harvard Univ., Boston. School of Public Health). Contract AT(30-1)-2355. 12p.

The performance of a respiratory protective system consisting of a packaged air cleaning unit with blower which delivers respirable air to a helmet enclosure was evaluated. A large number of milli-horsepower d-c motors were tested with blowers for application on the Mark I respirator system. A preliminary design was completed and prototype constructed of the Mark III respirator system. Mark IA and IIA respirator facepieces were fabricated of latex rubber. (M.C.G.)

2064 (AEC-tr-4670) INVESTIGATION OF THE RADIATION PURITY OF THE ATMOSPHERIC AIR AND OF THE RIVER NEVA IN THE REGION OF THE MOORING EXPERIMENTS OF THE ATOMIC ICEBREAKER "LENIN." A translation of "Issledovaniya Radiatsionnoi Chistoty Atmosfernogo Vozdukha i Reki Nevy v Raione Shvartovykh Ispytanii Atomnogo Ledokola 'Lenin.'" Yu. V. Sivintsev (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 27p.

At the time of the mooring test of the atomic icebreaker "Lenin" the amount of radioactive materials in the air of the central compartment and in the area of the main mast of the icebreaker has been determined, together with similar tests in the atmospheric air, in the river water, in the flora, and the fauna of the region adjoining the location of the tests. Results of the tests have shown that the nuclear energy generating system of the atomic icebreaker "Lenin" has a highly effective radiation safety system, thanks to which the operation of this vessel is completely safe for its attending personnel, for the mooring and a supply base of the icebreaker, and for the vessels following it in the convoy. (auth)

2065 (JPRS-10498) ELIMINATING HAZARDS FROM WASTE WATER CONTAINING RADIOACTIVE SUBSTANCES. A. A. Kastal'skii (Kastal'skiy). Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, 6: No. 2, 193-9(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31906.

2066 (NP-tr-793) PROTECTION OF FOOD AND WATER FROM CONTAMINATION BY RADIOACTIVE PARTICLES. B. Varyenishev. Translated from Voennoe Znaniya, No. 4, 18-(1956). 6p.

Methods of protecting food and water from radioactive contamination in home and warehouse conditions are described. Use of a dosimeter in determining the degree of contamination is discussed. Deactivation treatments for food and water contaminated in excess of acceptable limits are outlined. (M.C.G.)

2067 A STUDY OF BERYLLIUM EXPOSURES AT A HIGH EXPLOSIVE ASSEMBLY TEST FACILITY. Raymond O. Campbell (Univ. of California, Livermore). Am. Ind. Hyg. Assoc. J., 22: 385-91(Oct. 1961). (UCRL-6166)

Beryllium metal, included in high explosive assemblies when detonated, is vaporized, oxidized, and widely dispersed by wind and air currents, and that which remains is confined within a few hundred feet of the firing table. A description of the facilities involved and the results of a study of the degree of contamination are presented. Results indicate that the disturbing or moving of firing table material, such as by digging or raking, demonstrated the most significant findings. A program of personal hygiene and facility housekeeping for the protection of workers from beryllium contamination is described. (P.C.H.)

2068 PERSONNEL PROTECTION PROGRAM FOR INDUSTRIAL USE OF KRYPTON-85. E. I. Geller, F. X. Worden, G. Cassidy, and C. Y. Bartholomew (Western Electric Co., Allentown, Penna., and Bell Telephone Labs., Allentown, Penna.). Am. Ind. Hyg. Assoc. J., 22: 403-8 (Oct. 1961).

The change from radium bromide to krypton-85 as the residual ionization source in cold cathode gas discharge tubes was carried out to reduce radiation exposure to personnel during manufacture and use of the tubes. The personnel protection program, which had been in effect for radium bromide, was modified to conform to the special properties of krypton-85. This modified program consists of area monitoring, personnel monitoring, and occupational medical examinations. Some occupational exposure data are given and are compared to similar data for radium bromide. The use of krypton-85 has reduced the radiation exposure of the employees below the previously low levels encountered when radium bromide was used. (auth)

2069 EXPOSURE OF THE ROENTGENOLOGIST AND THE ASSISTING STAFF IN FLUOROSCOPIC EXAMINATIONS OF THE LUNG AND HEART. F. Petrovčić (General Hospital, Zagreb). Arhiv hig. rada i toksikol., 11: 117-30 (1960). (In Yugoslavian)

During x-ray examinations the patient, the physician and the assisting staff are exposed to the effects of radiation energy. It is therefore necessary to know the degree of exposure since all the protective measures depend on it. The aim of the measurement was to determine which quantity of radiation is effective in certain methods of fluoroscopy, to find out the least exposed working places, and finally to evaluate the efficiency of different protective appliances. The results of the measurements of the radiation intensity (in mr/h) to which the physician and the assisting staff are exposed in lung and heart fluoroscopy, working with full-wave and self-rectified units, in examining patients in upright or recumbent position, with and without the use of the protective Forssell chair and the protective cabin, are reported. The necessity of using protective gloves and apron is stressed. The protective cabin is especially useful when x-ray examinations have to be performed on a large scale. (auth)

2070 EXPOSURE OF THE ROENTGENOLOGIST AND THE RADIOGRAPHER IN FLUOROSCOPIC EXAMINATIONS OF THE DIGESTIVE TRACT. F. Petrovčić (General Hospital, Zagreb). Arhiv hig. rada i toksikol., 11: 131-40(1960). (In Yugoslavian)

The results of the measurements of radiation intensity (in mr/h) to which the roentgenologist and the radiographer are exposed in fluoroscopy of the digestive tract, working with full-wave and self-rectified units, examining patients in upright or recumbent position, with and without the use of the protective Forssell chair and the protective cabin, are reported. The necessity of using protective appliances, particularly in fluoroscopy of patients in recumbent position is pointed out. The results are compared with the measurements of others and the influence of some individual habits in fluoroscopy on exposure of the roentgenologist was investigated. (auth)

2071 A CASE OF ACCIDENTAL INHALATION OF $^{90}SrCo_3$. J. Rundo and Katharine Williams (Atomic Energy

Research Establishment, Harwell, Berks, Eng.). Brit. J. Radiol., 34: 734-40(Nov. 1961).

The urinary excretion of Sr^{90}, following acute accidental inhalation of strontium carbonate, was followed for 300 days; less complete data on fecal excretion were also obtained. The urinary excretion rate could be expressed as a three-component exponential function of time, with a fourth component to account for an initial increase in the excretion rate. This was considered to reflect a reservoir of the insoluble carbonate in the lung. Over the period of 20 to 304 days the urinary excretion rate could also be represented as a power function of time. The initial intake was calculated from the total excretion and from the activity found in a blood sample. The results were in agreement with the values obtained by measuring the Bremsstrahlung in a whole-body γ-ray spectrometer, and from an empirical equation relating retention to daily urinary excretion derived from a study of the retention in two men following intravenous injection of 0.5 μc strontium. (auth)

2072 SOME HETERODOX REMARKS ON RADIATION DOSIMETRY. H. R. Schinz and R. Wideroe (Universität, Zurich). Fortschr. Gebiete Rötgenstrahlen u. Nuklearmed, 95: 261-75(Aug. 1961). (In German)

By utilizing precise and rational terms, an attempt is made to suppress all "problematics" posed by measurements in the radiological domain. The measurement of radiation intensity (especially outside the body) is called radiometry and should be sharply differentiated from measurements inside the body, which is called dosimetry. In radiometry the unit of radiation density is the roentgen. This unit and the methods used to determine it (electron equilibrium) should be employed only in radiometry. The unit of dosimetry is the rad and the accessory unit for the determination of ionization is the rho. All dosimetric measurements should be made by the Bragg-Gray principle with thin-walled microchambers. The systematic application of these ideas together with terms as precise and clear as possible permits the elimination of problems and confusions existing at present. (tr-auth)

2073 HOOD VENTILATION IN ARGONNE'S PLUTONIUM FUEL FABRICATION FACILITY. R. M. Mayfield and H. Bairiot (Argonne National Lab., Ill.). Heating, Piping Air Conditioning, 33: No. 9, 124-9(Sept. 1961).

An evaluation is given of the hood ventilation system in Argonne's plutonium fuel fabrication facility. Operational difficulties, revisions made to the system, and the proper operation of the interrelated ventilation systems are discussed. The hood ventilation system employs either air or helium, the choice being largely a function of the state of the material and the operations being performed. The system controls the air in such a manner that the atmosphere within the laboratory and the surrounding community is safe for breathing. (N.W.R.)

2074 RADIOACTIVE SURVEY OF THE AREA OF BANGKOK AND DHONBURI. J. Natl. Research Council Thailand, 2: No. 2, 27-47(May 1961). (In Thai)

Soil and plant samples from 25 points in Bangkok and Dhonburi were collected for evaluation of total beta and total gamma activities. Radiation of water from three canals was also measured. Preparation of soil and plant samples was done by ashing and grinding. Water was evaporated and the residue obtained was ashed and ground. A GM counter and a well-type scintillation counter were made use of in counting. Potassium chloride was employed as standard source in calibration of GM counter. Calibration for scintillation counter employed cobalt-60 standard source. The results obtained are about the same level with those measured in the United States and England. (auth)

2075 A RAPID METHOD OF Cs-137 ISOLATION FROM RIVER AND DRINKING WATER. Miroslav Kyrš and Leo Neumann (Coll. of Chemical Tech., Prague). Jaderná energie, 7: 310-11(1961). (In Czech.)

Measurement accuracy demands knowledge of the concentration of the radioactive substances, the inactive ballast separation in the sample, and the individual isotope isolation. Possibilities of using the extraction process for isolating and concentrating radiocesium are determined. (L.N.N.)

2076 RADIOLOGICAL DOSIMETRY DEPARTMENT OF THE INSTITUTE OF NUCLEAR RESEARCH. Jaderná energie, 7: 360-4(1961). (In Czech.)

The origin, research program, instrumentation, radiation standards, radiation dose measurements, use of nuclear emulsions, the calibration of neutron standards, and other information on the Radiological Dosimetry Department of the Institute of Nuclear Research in Czechoslovakia is discussed. The collaboration of this Institute with other institutes is also discussed. (N.W.R.)

2077 EXPERIMENTAL STUDY OF β-RAY RADIATION. T. Otsuka (Keio Univ., Tokyo). Keio Igaku, 36: 1521-30(1959).

Applicators for β radiation of P^{32}, Sr^{89}, Sr^{90}, and Y^{90} were made and experiments were carried out. From 15—20 μc of P^{32}/sq cm and 16.5 μc of Sr^{90}/sq cm were absorbed on filter paper; dry vinyl wax was applied and the paper was backed by Pb plate 0.3 mm thick. This was kept in a polyethylene bag and then used clinically as a safe radiation source. Handling of Sr^{90} had to be especially careful. The dose was measured by an extrapolation chamber; 16.5 μc/sq cm of Sr^{90} was 6 rad/μch, 15 μc/sq cm of P^{32} was 3.6 rad/μch. The dose of 16.5 μc/sq cm of Sr^{90} through a paraffin plate (specific gravity = 0.92) was measured by a film density method using Kodak x-ray film. The transit dose was 75% for paper 1 mm thick, 47% for 2 mm, 33% at 3 mm, zero at 8 mm. 16.5 μc/sq cm of Sr^{90} was applied to the skin surface of the back of guinea pig and the reaction studied macroscopically and histologically. Macroscopically slight dry dermatitis was seen at 800 μch and wet dermatitis at 1200 μch. Re-epithelization was seen at about 1 week, when the low dose was applied and at about 3 weeks in high-dose radiation. Histologically, immediately after radiation degeneration of the basal cells and condensation and swelling were seen. In the corium there was edema, swelling of the connective tissues, and leucocyte and lymphocyte infiltration. These changes were slight at 800 μch, which reached a maximum at about 1 week, but at 1500-2000 μch were severe (destruction of the basal cells associated with erosion or ulceration); after 3 weeks regeneration of epithelial cells was seen. During recovery there was a marked increase in basal cells, connective tissues, and fiber formation. In the guinea pig the dose causing dry and wet dermatitis was 1000-1200 μch which was higher than that in humans and recovery was relatively faster than that of human skin. (Abstr. Japan Med., 1: No. 12, 1961)

2078 PROBLEMS OF MEASURING BETA DOSES, AS ILLUSTRATED BY AN EXAMPLE. W. Bickel (Technische Uberwachungs-Verein, Bavaria, Ger.). Kerntechnik, 3: 452-3(Oct. 1961). (In German)

Difficulties in determining beta doses in practical radiation protection are pointed out. By way of an example, it is demonstrated that the questions raised can frequently be answered satisfactorily by making estimates even without a precise determination of the doses. (auth)

2079 CONCERNING PROPHYLAXIS OF RADIATION INJURIES CONSEQUENT UPON CLINICAL APPLICATION OF I^{131} AND Au^{198}. D. A. Ulitovskii (Kirov Medical Military Academy of Order of Lenin, [USSR]). Med. Radiol., 6: No. 10, 33-7 (Oct. 1961). (In Russian)

Time intervals of maximum permissible radiation doses of I^{131} and Au^{198} for man are given at various rates of activity and different distances. Diagrams are proposed, which, being plotted in logarithmic coordinates, present convenient tools for practical use with the view to a rapid estimation of maximum permissible time period of operation under given conditions. (auth)

2080 ON THE PROBLEM OF PROTECTION AGAINST RADIATION HAZARDS IN THE CURIETHERAPY OF AFFECTIONS INVOLVING FEMALE GENITAL ORGANS. Ishtavan Berta and Yanosh Felserfalvi (Debrecen Medical Inst. and Inst. of Applied Physics, Debrecen Univ., Hungary). Med. Radiol., 6: No. 10, 38-9 (Oct. 1961). (In Russian)

A description is given of protective arrangements of the premises and also of means for individual protection during the use of curietherapy of affections involving female genital organs. (auth)

2081 THE SAFETY OF MEDICAL PERSONNEL WHILE PERFORMING INTRACAVITARY RADIATION THERAPY PROCEDURES. Yu. Kh. Sarkisyan and G. A. Zubovskii (State Scientific-Research Inst. of Roentgen-Radiology, RSFSR). Med. Radiol., 6: No. 10, 39-45 (Oct. 1961). (In Russian)

A detailed analysis of the conditions underlying radiation hazards for medical staff engaged in applying intracavitary therapy by means of linear and volumetric (macro-suspensions) sources of Co^{60} are given. Evidence was gained that the realization of both these methods of radiotherapy is attended with the irradiation of the physician and the nurse in doses inferior to maximally permissible ones, and with the irradiation of ward-attendants with doses equal to or above the established levels (during transportation of the patients from treatment rooms to their respective wards). With the use of a special safety device for the administration of macrosuspensions, the irradiation doses to which the personnel is exposed are appreciably lower than those noted in handling linear sources. (auth)

2082 THE AIMS OF DOSIMETRIC CONTROL WHILE DEALING WITH URANIUM AND URANIUM-CONTAINING PRODUCTS. O. S. Andreeva. Med. Radiol., 6: No. 10, 46-52 (Oct. 1961). (In Russian)

A brief review of basic nocivity factors appearing in the handling of uranium-containing products is given. Particular attention is being paid to the issues of dosimetric control in dealing with the uranium mineral, its ores, salts, and with metallic uranium. (auth)

2083 ESTIMATION OF A GENERAL INTEGRAL DOSE IN A LOCAL X-RAY AND GAMMA-RAY IRRADIATION. R. T. Mamin and R. Kh. Tenishev (State Scientific-Research Inst. of Roentgen-Radiology, Ministry of Health, RSFSR). Med. Radiol., 6: No. 10, 69-73 (Oct. 1961). (In Russian)

The question of estimating an integral dose of secondary radiation in the body, originating as the result of interaction between the primary x rays and gamma rays with the ground substance is discussed. The proposed method of computation enables it to approximately estimate both the total integral dose in the whole of the body and the local integral dose, or the doses in individual portions of the body. The calculations made and experimental research work demonstrate the total integral dose absorbed by the body in a local irradiation to considerably (under certain conditions) exceed the integral dose determined with the consideration of the primary rays only. (auth)

2084 SYSTEMATIC MEASUREMENT OF FALL-OUT IN CZECHOSLOVAKIA UP TO 1961. W. Santholzer, G. Macku, and J. Podzimek (Charles Univ., Prague). Nature, 192: 398-400 (Nov. 4, 1961).

Systematic measurements of fall-out in precipitation in Hradec Králové, Czechoslovakia, during the past four to five years provided evidence that the activity of radioactive fission products from fall-out during November 1956 to December 1959 showed a trend similar to that in Norway. The peak of the activity in April 1959 was 3.960 μμc/l precipitation. The minimal value during November to December 1959 was about 20 μμc/l. The increase in activity of rain water in March 1960 after the first French nuclear test in the Sahara Desert on February 13, 1960, was very pronounced but transitory. Activity of fission products reached its highest level in the collection of rain water of March 1, 25.9 mμc/l. In addition to the collection of rain water samples, the fall-out was collected every second or third day by the pot method. The data are presented in graphical form. (P.C.H.)

2085 RADIOACTIVE FALL-OUT AND THE TESTING OF NUCLEAR WEAPONS. Statement by the Medical Research Council. Nature, 192: 400-3 (Nov. 4, 1961).

Following the resumption of nuclear weapon testing in the atmosphere by the U.S.S.R., a review is given on the following subjects: mechanism of deposition of fall-out; types and sources of radiation exposure from fall-out; assessment of the hazard from fall-out prior to the present tests; estimation of additional exposure due to recent atmospheric tests; possible consequences of the explosion of a fifty-megaton bomb; and arrangements for monitoring and assessing the fall-out situation. Discussion is also given on the measurement of I^{131} in milk in central and southern England, Wales, Scotland, and Northern Ireland. The data are tabulated. (P.C.H.)

2086 RADIOACTIVITY IN RAINFALL DURING SEPTEMBER 1961 FOLLOWING THE RUSSIAN NUCLEAR-WEAPONS TESTS OF SEPTEMBER 1961. Keith Boddy (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nature, 192: 443-4 (Nov. 4, 1961).

From the analyses for total beta activity it is evident that the residue from rain falling after September 2, 1961, had an activity which was of a distinctly higher order (up to 800 μμc/g) than that of the previous month's rainfall (about 160 μμc/g). The activity of the rain water in this period was correspondingly greater (48.4 μμc/l) compared with previous months (about 5.1 μμc/l). To confirm that the excess activity was due to fission products, specific isotopic analysis was carried out for I^{131}. (P.C.H.)

2087 HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SEVENTH CONGRESS, FIRST SESSION ON RADIATION SAFETY AND REGULATION, JUNE 12, 13, 14, AND 15, 1961. (United States. Congress. Joint Committee on Atomic Energy). 439p. GPO.

Hearings were held before the Joint Committee on Atomic Energy of the Eighty-Seventh Congress of the United States on June 12, 13, 14, and 15, 1961 on the subject of Radiation Safety and Regulation. A number of scientists and engineers presented testimony as to current developments in the field of reactor safety and radiation safety generally. The SL-1 accident at the National Reactor Testing Station in Idaho on Jan. 3, 1961 was discussed. Recent proposals for a revision of the AEC regulatory organization were reviewed. (C.H.)

2088 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY. NUMBER 24 FOR JANUARY–MARCH 1961. Tokyo, The Japan Meteorological Agency, 1961. 99p. (In English and Japanese)

Data are tabulated on the radioactivity in samples of rain water and dust collected at a number of stations throughout Japan during January, February, and March, 1961. (C.H.)

2089 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, NOVEMBER 1961. Volume II, Number 11. (Public Health Service, Washington, D. C.). 36p. $0.50 (GPO).

Data are presented on air surveillance, milk monitoring, the national water quality network activities, external gamma activity, and environmental levels at AEC installations. (J.R.D.)

2090 REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. NOTES ON CERTAIN ASPECTS OF THE REGULATIONS. "Safety Series No. 7" of the International Atomic Energy Agency, Vienna. (International Atomic Energy Agency, Vienna). 1961. 107p. (STI/PUB/32). $1.50(IAEA).

The regulations are given in terms of: a layman's guide and synoptic tables of the regulations; classification of radioisotopes for packaging; derivation of maximum permissible levels of radioactive surface contamination of transport containers and vehicles; and appropriate tests for containers for transport of radioactive materials. Included is an example of assessment of exposure for transport personnel at the British European Airways cargo warehouse, London Airport, 1958. (B.O.G.)

2091 DEVICES FOR PROTECTION AGAINST IONIZING RADIATION AND CONTAMINATION BY HARMFUL DUSTS IN APPARATUS FOR OBSERVING THE INTERIOR OF SEALED CHAMBERS. (to Commissariat a l'Energie Atomique). British Patent 881,007. Nov. 1, 1961.

An optical apparatus for observing the interior of sealed chambers containing radioactive materials is designed with means for preventing contamination by dust from the chamber and for blocking nuclear radiation. The apparatus includes a cylindrical envelope which is accommodated in an opening in the chamber and surrounded by bellows when not in operating position, and at least two cylindrical lead screens disposed in the envelope with a prism arranged to direct light rays from an opening in one screen to another opening in the other screen. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

2092 (ANL-6421) RADIOISOTOPE TECHNIQUES FOR CHEMICAL, PHYSICAL, AND INDUSTRIAL APPLICATIONS. Andrew J. Cassell (Argonne National Lab., Ill.). Sept. 1961. Contract W-31-109-eng-38. 85p.

A laboratory manual is given consisting of 14 experiments designed to teach some of the basic fundamentals of the application of radioisotopes, and to introduce the principles of radioisotope technology. The majority of the experiments, while designed to be practical, are planned for scientists having little background in radiochemical and radioisotope technology, and the remainder are outlined for more advanced personnel. The experiments include isotope production, sample preparation and half life determination, radioactive decay mixture of independent decaying activities, preparation of carrier-free solutions, solubility measurements, tracer techniques by exchange kinetics, diffusion studies, determination of deposit thickness, blending efficiency, beta and liquid level gaging, special handling of radioisotopes in hot cell operations, autoradiography, engine wear studies, and decontamination of radioactive spillage. (B.O.G.)

2093 (BMI-X-179) RADIOISOTOPE AND RADIATION APPLICATIONS; QUARTERLY PROGRESS REPORT. SECTION I. USE OF INTRINSIC RADIOACTIVE TRACERS FOR PROCESS CONTROL. James L. McFarling, Peter Gluck, John F. Kircher, and Duane N. Sunderman. SECTION II. RADIATION-INDUCED GRAFT-POLYMERIZATION STUDIES. Francis A. Sliemers, Manfred Luttinger, Emir Guelbaran, William B. Gager, Robert Lieberman, John F. Kircher, and Robert I. Leininger (Battelle Memorial Inst., Columbus, Ohio). Oct. 23, 1961. Contract W-7405-eng-92. 17p.

Research was continued in the areas of intrinsic radioactive tracers for industrial process control and the influence of structural factors in radiation-induced graft polymerization. The use of in-process isotope neutron sources to produce short-lived radiotraces is discussed. A 10c Po—Be neutron source was obtained for exploratory experiments. The design and construction of a neutron-source storage shield and an activation-cell holder are underway. The effect of structural factors on the efficiency of free-radical site formation in acrylate and methacrylate polymers was emphasized. Site measurements versus dose were made for poly-n-hexylmethacrylate. Two additional methods for measuring free-radical concentrations, a chemical method employing diphenylpicrylhydrazyl and hydroquinone and a method based on molecular-weight decreases, were developed. The grafting studies were continued. (M.C.G.)

2094 (NP-10946) ANALIZA IZOTOPOWYCH METOD POMIAROWYCH I REGULACJI WIELKOSCI FIZYCZNYCH. (Isotopic Analysis Measurement and Regulation). Jerzy Czarnecki and Stanisław Kowalik (Poland. Biuro Urzadzen Techniki Jadrowej, Warsaw). [nd]. 72p.

The use of radioactive materials is being developed to the point where radiation from radioactive isotopes can be safely and effectively used in process control, quality control, and level measuring systems. Radiation sources can be used in width and thickness gaging devices. Some of the various properties of radiation (scattering, reflection, absorption) can be utilized in density and liquid level measuring instruments for closed systems. These properties can also be applied for use in flow control devices in conjunction with the density or level measuring instruments. Equations which can be used for determining the accuracy and the precision of isotopic radiation measurement methods are presented. Statistical errors and instrument errors must be considered in the measurements. Derivations of these equations are shown, and graphic data used in solutions of these equations for the different utilization systems are presented. The methods used for choosing a source material, based on the system and on its operating parameters, are given. Graphic methods for calculating the activity of radiation sources, such as Cs^{137} and Co^{60}, are presented. Nomograms for use in these calculations are also given. (R.P.R.)

2095 (TID-14226) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report No. 11, June 15, 1961 to September 15, 1961. (Chicago. Univ. Labs. for Applied Science). Contract AT(11-1)-712. 37p.

A search was made of technical literature not previously surveyed on moisture determination of coal in large storage piles. The final set of equipment-vendor justification memoranda for the ancillary equipment required for use with the pulse height analysis system used in chemical analysis of solids by Rutherford scattering were approved. A study of the capabilities of the method, its sensitivity, and the influence of the design parameters is under way. The Gammacon tube, an imaging multiplier phototube for a gamma pinhole camera is discussed. (M.C.G.)

2096 ON THE STERILIZATION OF PHARMACEUTICAL PRODUCTS BY IONIZING RADIATION. P. Bonèt-Maury and Ch. Lormand. Ann. pharm. Franc., 17: 34-5 (Jan. 1959). (In French)

Some bacterial cultures, injectable solutes, and wound dressings were subjected to a Co^{60} source of 800 curies. The dose assuring complete sterilization, without altering the physical properties, was determined for each of the irradiated products. (P.C.H.)

2097 RADIOACTIVE ISOTOPES. P. F. Berry (Wantage Research Labs., Berks, Eng.). Brit. Power Eng., 3: No. 4, 40-5(Sept. 1961).

An outline is given of some developments in the use of radioisotopes in radiation interaction techniques and tracer applications. In regards to radiation interaction techniques, the following types of gages are described and the methods used with these gages are explained: level, radiation absorption, and preferential radiation absorption gages. The following tracer applications are also described: velocity measurements, flow pattern investigation in liquids and solids, dilution technique, wear and lubrication studies, and liquid and gas leak detection. (N.W.R.)

2098 IMPROVEMENTS IN VULCANIZING RUBBER. (to U. S. Rubber Co.). British Patent 881,281. Nov. 1,1961.

The radioinduced vulcanization of rubber can be effected with smaller amounts of ionizing radiation by carrying out the vulcanization in the presence of acrylate, diacrylate, or dimethacrylate compounds. The properties of rubber vulcanized in this way are generally superior to those of rubber radio-vulcanized without an additive. (D.L.C.)

2099 TREATMENT OF PETROLEUM AND PETROLEUM PRODUCTS BY IRRADIATION. Simon Lyon Ruskin, Dan Ruskin, Milton Reder, and Carol Farhi. British Patent 881,492. Nov. 1, 1961.

A process is described which improves crude petroleum oils and residues from refining operations by means of exposure to 50 to 400 Mr gamma radiation in the presence of a catalytic metal, preferably with the use of a cobalt bomb. In this way, the specific gravity and viscosity of the oil are decreased, probably by an increase in the volatile content, and the color is changed from black to fluorescent green or amber. (D.L.C.)

ISOTOPE SEPARATION

2100 (TID-13427) ISOTOPIC FRACTIONATION OF NITROGEN IN THE NITROGEN OXIDE–NITRATE EXCHANGE SYSTEM. Marvin J. Stern, Lois Nash Kauder, and W. Spindel (Rutgers Univ., Newark, N. J.). [1961]. Contract [AT(30-1)-2250]. 26p.

The single-stage fractionation factors for nitrogen exchange between nitric oxide and nitrate salt solutions were found to range from 1.073 at 25° to 1.056 at 70°. The experimental values are about 0.007 less than the values calculated from spectroscopic data, a result not unexpected, since the statistical-mechanical calculations do not take interactions in a condensed phase into account. Within the estimated experimental error of ±0.004, the isotope effect appeared to be independent of the nature and degree of complexing of the nitrate ion in solution. Measurements were also made of the fractionation factors between nitric oxide and nitric acid solutions (1 to 12M) over the temperature range from 25° to 70°C. The formation of additional oxy-nitrogen species in both phases introduced additional exchange reactions which lowered the over-all isotope effect significantly. Due to the changes in the chemical compositions of the phases, the observed factors went through a maximum in the vicinity of 6M nitric acid. The experimental effective fractionation factors were in general agreement with the values calculated from the chemical compositions of the systems and the partition function ratios for the chemical species involved. (auth)

2101 (TID-13776) SEPARATION OF ISOTOPES. Annual Progress Report. A. Narten, A. R. Gupta, M. Jeevanandam, H. M. Taylor, and T. I. Taylor (Columbia Univ., New York). Sept. 1, 1961. Contract AT(30-1)-755. 102p. (CU-14-61 AT(30-1)755 Chem.).

The chemical exchange systems NO-HNO$_3$ and NO-N$_2$O$_3$ as described previously were successful in the preparation of over 99% N^{15} and the exchange of NO with nitric acid solutions appeared promising for the concentration of O^{18}. These systems require chemical reflux. Exchange-distillation systems have the desirable feature of not requiring chemical reflux. Several such systems for concentration of N^{15} or O^{18} were considered. They include the following exchange reactions: nitric oxide with nitric oxide complexes of cupric chloride and cupric bromide in non-aqueous solvents; nitric oxide with nitrosonium salt solutions; nitric oxide with nitrosyl bromide; carbon dioxide with non-aqueous solutions of carbamates; and nitrogen dioxide with liquid dinitrogen tetroxide. Of the systems involving nitric oxide, its exchange with complexes of nitric oxide and cupric chloride in methanol solutions was the most promising for the concentration of N^{15}. The enrichment factor was found to be 1.017 at −20°C. Experiments with exchange-distillation columns showed that the exchange was rapid. Stage heights of 2.2 to 3.0 cm were obtained at interstage flows of 1.0 and 1.3 m moles of nitric oxide per cm^2-min at temperatures from −20° to 14°C. O^{18} concentrated along with the N^{15}, but to a lesser extent. The favorable enrichment factor for the exchange of O^{18} between carbon dioxide and water (1.038 at 25°C) made the system an attractive one for the concentration of O^{18}, provided the exchange could be effectively catalyzed. The effect of several catalysts on the rate of the exchange was investigated. Of the substances investigated, mixtures of amines and selenous acid exhibited the most pronounced catalytic effect. The problems concerned with the use of these catalysts in the exchange columns were considered. Preliminary results were also obtained on exchange-distillation systems involving carbon dioxide and carbamate formation with non-aqueous solutions of amines. The reflux reactions for the concentration of O^{18} by the exchange of nitric oxide with nitric acid solutions and the use of the exchange reaction between nitrogen dioxide and liquid dinitrogen tetroxide in a two-temperature system are described. The effective separation factor for a particular isotopic species in a multicomponent mixture of isotopes such as occurs in the distillation of nitric oxide or water, is discussed. (auth)

2102 (CEA-tr-X-403) SEPARATION DES ISOTOPES RADIOACTIFS AU MOYEN DE LA MEMBRANE ECHANGEUSE D'IONS. CONCENTRATION DE ^{90}Y A PARTIR DE LA SOLUTION AQUEUSE DU SYSTEME ^{90}Sr-^{90}Y. (Separation of Radioactive Isotopes by Means of Ion Exchange Membranes. Concentration of Y^{90} Starting with Aqueous Solutions of the System Sr^{90}−Y^{90}). Hidehiro Goto, Susumu Suzuki, and Makoto Saito. Translated into French from Nippon Kagaku Zasshi, 81: 578-82(1960). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 11073.

2103 (UCRL-Trans-552(L)) CONCENTRATION OF ARTIFICIAL RADIOACTIVE ISOTOPES OF GROUPS IV AND V BY THE METHOD OF RECOIL ATOMS. A. N. Murin and V. D. Nefedov. Translated by Esther Goldberg (Univ. of California Lawrence Radiation Lab., Livermore) from Primenenie Mechenykh Atomov v Anal. Khim., Akad. Nauk S.S.S.R., Inst. Geokhim. Anal. Khim. im. V. I. Vernadskogo, 75-8(1955). 6p.

Methods of producing concentrated preparations of radioactive isotopes extracted by the (n,γ) reaction for Groups IV and V are described. Si^{31}, Ge^{75}, P^{32}, Sb^{122}, and Sb^{124} were prepared and concentrated. (M.C.G.)

2104 THE SEPARATION COEFFICIENT OF LITHIUM ISOTOPES IN VACUUM DISTILLATION. S. G. Katal'nikov and B. M. Andreev. Atomnaya Energ., 11: 240-4(Sept. 1961). (In Russian)

The separation coefficient of metallic Li was determined in an experimental device consisting of a stainless steel still, a vacuum system, and a mixer. The Li vapors condensed on the water-cooled roof of the still. It was found that in the range between molecular and equilibrium distillation the value of the effective separation coefficient depends greatly on the geometrical dimensions of the still and on the evaporating and condensing surfaces. For the temperatures of 543, 469, and 406°C at which the Li vapor pressure is 10^{-4}, 10^{-3}, and 10^{-2} mm of Hg, the values of the effective separation coefficients found were 1.026 to 1.030, 1.033 to 1.042, and 1.060 ± 0.002 at each temperature, respectively. These figures may be used for calculating the dimensions of the separation columns. (TTT)

2105 ON THE OPTIMUM CASCADE OF MANUFACTURING OF HEAVY WATER AS A BY-PRODUCT IN THE WATER-ELECTROLYSIS PLANT. ELECTROLYSIS-EXCHANGE REACTION + WATER RECTIFICATION + RECOVERY ELECTROLYSIS. Masami Shimizu (3rd Tech. Div., Showa Denko K. K., Japan). Kunio Kawashima, Saburo Nitō, and Shōzō Matsumoto. J. At. Energy Soc. Japan, 3: 770-8(Oct. 1961). (In Japanese)

An analysis to get the most economical combination of three methods of heavy water enrichment, such as electrolysis-exchange reaction, distillation, and recovery electrolysis was made under the condition that the heavy water solution, by-product from a normal water electrolysis plant, is available as a raw material. As the result, the following combination was obtained as the optimum enrichment cascade in the case being planned: 4 stages of electrolysis-exchange towers with yields up to 3 wt. % D_2O; distillation plant with yields from 3 to 28.8 D_2O; and recovery electrolysis plant with yields from 28.8 to 99.8 D_2O. (auth)

2106 IMPROVEMENTS IN OR RELATING TO PROCESSES OF HEAT RECOVERY BETWEEN GAS HUMIDIFICATION AND DE-HUMIDIFICATION PROCESSES. Henry Reginald Clive Pratt (to United Kingdom Atomic Energy Authority). . British Patent 881,941. Nov. 8, 1961.

A process is given for more efficient heat recovery between a gas humidification process and a gas dehumidification process. The process comprises carrying out the humidification and dehumidification processes each in at least two successive stages so that the operating lines on a total heat of gas vs heat of humidifying liquid graph more nearly approximates the saturation curve without intersecting it, heat being transferred between reciprocal stages of said processes. The process of heat recovery is particularly applicable to enrichment of hydrogen in deuterium by isotope exchange with vaporized water or nitrogen. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 1993, 2381, and 2687

2107 (AEEW-R-98) PIG 3—A SIMPLE COMPILER FOR MERCURY. D. C. Bindon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). June 1961. 11p.

A short machine language compilation scheme for relocating large programs in drum storage is described which will read programs from paper tape, punched cards, or magnetic tape. The compiler occupies pages 8 to 15 of the ferrite store during translation. (auth)

2108 (DEG-Report-140) A MERCURY PROGRAM FOR THE SOLUTION OF SIMULTANEOUS FIRST-ORDER TOTAL DIFFERENTIAL EQUATIONS OF BASICALLY LINEAR FORM. B. E. Roberts (United Kingdom Atomic Energy Authority. Development and Engineering Group, Risley, Lancs, England). July 7, 1961. 26p.

A general description is given of programs for the Ferranti "Mercury" computer which solve, by means of an implicit difference technique, a system of first-order differential equations of basically linear form. These programs were developed primarily for the investigation of the transient behavior of reactor systems and the investigation of automatic control systems. In the large majority of such problems the equations describing the system are reduced to a set of first-order total differential equations either by using a 'point reactor' representation or by the replacement of spatial derivatives in terms of finite differences. The design of the basic program was influenced by the work for which it was intended but was kept sufficiently general for the program to be of use in a wide variety of other problems which may be described in terms of such a system of equations. The method chosen for solution was a simple implicit difference step-by-step method which is unconditionally stable in that any error introduced at one step is not magnified at the next. The necessity of iterating to solve these implicit difference equations (by a process which is convergent for all but the most 'pathological' cases) is more than offset by the larger interval which will yield satisfactory integration as compared with similar-order explicit difference methods. The basic program was designed in such a way as to minimize the additional programming required before a problem was ready to go into the computer. A truly linear set of equations requires only a data tape and a test for the termination of the run. On the other hand varying coefficients must be calculated by an auxiliary program. (auth)

2109 (DESY-A2.80) A FAST ANALOG COMPUTER FOR BEAM ENVELOPES AND PARTICLE TRAJECTORIES. W. Kern and K. G. Steffen (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 14, 1961. 10p.

An analog computer method for the calculation of beam envelopes was developed and a system consisting of an analog computer with some additional electronic equipment was constructed. The computer is capable of calculating beam transport systems composed of the following elements: quadrupoles, bending magnets, synchrotron-type magnets with combined focusing and bending action, and electrostatic mass separators. The use of the beam envelope method is demonstrated by a specific example. The sources of error in the system and design improvements are discussed. (M.C.G.)

2110 (K-1494) TØSS—AN IBM-7090 CODE FOR COMPUTING TRANSIENT OR STEADY STATE TEMPERATURE DISTRIBUTIONS. David Bagwell (Oak Ridge Gaseous Diffusion Plant, Tenn.). Dec. 1, 1961. Contract W-7405-eng-26. 80p.

A program was written, for the IBM-7090, which will solve the heat-transfer equations for the transient and/or steady-state temperature distribution of a three-dimensional irregular body using a first-forward difference method. Given the geometrical and physical description of the assembly, TØSS will give as output the temperature distribution as a function of time. Ease of input, clear and compact output, and efficient computation were the principal considerations in designing the code. (auth)

2111 (KAPL-M-EC-9) TANK. POWER PLANT TRANSIENT ANALYSIS PROGRAM. M. A. Ketchum (Knolls Atomic Power Lab., Schenectady, N. Y.). July 6, 1961. Contract W-30-109-Eng-52. 77p.

The equations used in TANK represent a closed loop system with two primary coolant loops, a single channel reactor, secondary steam system, and pressurizer. The program was designed to study the transient performance of this model as a function of the bulk average temperature, pressure, coolant flow, and reactivity with options which allow running at constant pressure, constant power, or with no ship's motion. Other features include tables for the pumps, throttle setting, and control rod reactivity. The limits on N, the total number of nodes representing either of the two coolant loops, are $3 \leq N \leq 75$ and the maximum number of active nodes in the core is 15. Running time for a problem can be estimated by allowing about 0.17 sec per time step. (auth)

2112 (KAPL-M-EC-12) CURFIT—CURVE FITTING PROGRAM. James A. Warrington (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 6, 1961. Contract W-31-109-Eng-52. 51p.

CURFIT is a digital computer program which is a composite made up of several different curve fitting methods in one package. For the convenience of the user, options were included to allow various input formats and methods of weighting. The fitting methods included in this program are: polynomial ($Y = \sum_{i=0}^{n} a_i x^i$, $n \leq 10$) for up to 300 points; exponential ($Y = ae^{bx}$) for up to 300 points; cosine ($Y = a \cos b(x + c)$) for up to 300 points; system of linear equations ($Y = \sum_{i=1}^{n} a_i x_i$) up to 200 equations, 50 unknowns; and series of cubics ($Y = a_j + b_j x + c_j x^2 + d_j x^3$ j according to x) for up to 50 points. The input is supplied as the coordinate points describing the curve to be fitted. The program running time for each case should not exceed more than one minute. (auth)

2113 (MURA-629) THE PARMESH DYNAMICS PROGRAM. Jess Anderson and George Parzen (Midwestern Universities Research Assn., Madison, Wis.). Sept. 22, 1961. Contract AT(11-1)-384. 11p.

The PARMESH dynamics program is a Fortran Program which integrates the equations of motion of a particle in a magnetic field. The magnetic field is computed on a mesh which is written on tape. Various field inputs are available, only one of which is described. The magnetic field is entered on the median plane. The field off the median plane is calculated as a power series in z by numerically differentiating the median plane field. (auth)

2114 (NRL-5667) DATA REDUCTION IN PHYSICS. [Interim Report]. Robert G. Glasser (Naval Research Lab., Washington, D. C.). June 27, 1961. 50p.

A discussion of the fundamental statistical methods which have been applied to data reduction in physics is presented. A summary of probability theory, an examination of some important statistical distributions, a discussion of the foundations of statistics, and selected applications are included. (auth)

2115 (TID-14158) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. CIRCUIT RESEARCH PROGRAM. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). July 1961. Contract AT(11-1)-415. 46p.

Progress in the development and use of computers is reported. The high-speed computer program, circuit research program, data reduction methods, Illiac use and operation, IBM 650 use and operation, and general laboratory information are discussed. (M.C.G.)

2116 (UCRL-9099) REFERENCE MANUAL FOR KICK IBM PROGRAM. Arthur H. Rosenfeld, ed. (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 167p.

A reference manual describing the IBM 704 program called Kick, by which complete bubble chamber events are kinematically analyzed is presented. Kick's input data is the output from the Pang program, which uses raw track measurements to spatially construct the tracks, and fits appropriate curves to them. (auth)

2117 (UCRL-9727) OPTIK: AN IBM 709 COMPUTER PROGRAM FOR THE OPTICS OF HIGH-ENERGY PARTICLE BEAMS. Thomas J. Devlin (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 15, 1961. Contract W-7405-eng-48. 30p.

A program was developed for the IBM 709 digital computer to handle many of the problems encountered in the optical design of high-energy particle beams. The program employs a six-dimensional vector space that takes into account the position and direction in both planes perpendicular to the beam direction, chromatic aberrations and particles of different mass. The quadrupole problem with one or two degrees of freedom (i. e., one or two singlets, a doublet, or a symmetric triplet) is solved for the field gradients necessary to yield given beam conditions. The vectors are evaluated at the end of each element in the system. Effects higher than first-order, with the exception of second-order chromatic aberrations in the quadrupoles, are not included. The effect of apertures is calculated in terms of the limitations on the phase-space volume that can be transmitted by the system. (auth)

2118 A 48-BIT PSEUDO-RANDOM NUMBER GENERATOR. Heidi G. Kuehn (Westinghouse Electric Corp., Pittsburgh). Communs. ACM (Assoc. Computing Machinery), 4: 350-2(Aug. 1961).

A 48-bit pseudo-random number generator, suitable for several computers, was tested statistically for randomness to determine its adequacy for use in Monte Carlo programs. Frequency tests, distributions of certain low-order moments, runs up and down, and runs above and below the mean were applied to one-half million generated numbers lying within the interval (0, 1) and to three sets of integers obtained from specified bits within the generated numbers. These tests substantiated the randomness of all numbers except for the set of integers coming from the least significant bits. (auth)

2119 ON A TRACE PROBLEM. Jacques Louis Lions. Rend. seminar. mat. univ. Padova, 31: 232-42 (1961). (AFOSR-1443). (In English)

The spaces spanned by $u_1(0)$ and $u_2(0)$ when u_1 and u_2 span the space $W(p, \alpha, D(\Lambda), E)$ are characterized, subject to the condition $\Lambda u_1 + u_2' = 0$. Necessary conditions given are conjectured to be sufficient; proof is given in the Hilbert case. (L.N.N.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

2120 (ASD-TR-61-66(Pt.I)) DEVELOPMENT AND EVALUATION OF HIGH TEMPERATURE PROTECTIVE COATINGS FOR COLUMBIUM ALLOYS. PART I. COATING DEVELOPMENT. R. A. Jefferys and J. D. Gadd (Thompson Ramo Wooldridge Inc., Cleveland). May 1961. Contract AF33(616)-7215. 103p.

A study was made of the formation and protective nature of surface alloy diffusion coatings for niobium. Vacuum vapor deposited, diffusion alloy coatings combining chromium, titanium, and silicon were found to protect D-31 alloy, F-48 alloy, and unalloyed niobium from surface oxidation or internal contamination for considerable lengths of time in air at 2000 to 2600°F, and for shorter periods to 2800°F. Tests on the coating-base metal systems included cyclic oxidation, thermal shock, and high velocity-hot gas erosion in a plasma flame. (auth)

2121 (NYO-2576) APPLICATIONS OF ULTRASONIC ENERGY. Task 1. ULTRASONIC CHEMICAL PROCESSING. Task 2. ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. Task 3. ULTRASONIC INSTRUMENTATION. Progress Report No. 22, Covering Period from June 1, 1960 to July 31, 1960. (Aeroprojects, Inc., West Chester, Penna.). Aug. 1960. Changed from OFFICIAL USE ONLY June 23, 1961. Contract AT(30-1)-1836. 46p.

In chemical processing, ultrasonic activation of U_3O_8 in molten Mg−Zn is reported in which greater than 99% reduction was obtained in 2 hr. Ultrasonic dissolution of high-fired 96% ThO_2-UO_2 fuel pellets in HNO_3 resulted in complete residue-free solution with a 250% increase in rate. Nionel and titanium are suitable acoustic couplers for this system. Direct ultrasonic activation of ¼-in.-thick intact U−graphite fuel-plate specimens for 18 hr resulted in 99.6% total dissolved uranium in contrast to 92.2% for nonultrasonic leaching for 20 hr. In ultrasonic metal and ceramic-powder processing, reduction of the extrusion load for alumina formulations from 7000 to 1200 psig by combined ultrasonic activation of the die and container is reported. Ultrasonic slip casting increased the sintered densities of ceramic formulations by as much as 14%. Plate type simulated fuel elements were successfully recovered from porous molds after slip casting under ultrasonic activation. In ultrasonic instrumentation, couplers with improved sensitivity were assembled, and acoustic attenuation and impedance measurements are in progress. (For preceding period see NYO-2575.) (J.R.D.)

2122 (JPRS-10385) SEVERAL PROBLEMS OF THE TECHNOLOGY OF THE CATALYTIC PRODUCTION OF LIQUID PARAHYDROGEN. R. A. Buyanov, A. G. Zel'dovich, and Yu. K. Pilipenko. Translated from Khim. Prom., No. 2, 31-4(Feb. 1961). 10p.

Liquid para-hydrogen is obtained by means of the transformation of ortho-hydrogen using various catalysts at 21 to 24°K in a reactor included directly in a hydrogen liquefier system. Wiring diagrams for reactors are discussed. The optimal conditions for the operation of the reactors were determined and loads recommended. Several problems of catalyst activation were analyzed. Poisoning tendencies and working life of catalysts were also studied. (M.C.G.)

2123 PREPARATION OF HIGH-PURITY BERYLLIUM BY THE CHLORIDE METHOD. I. E. Vil'komirskii, G. F. Silina, A. S. Berengard, and V. N. Semakin. Atomnaya Energ., 11: 233-9(Sept. 1961). (In Russian)

Although the chloride method of preparing Be was recognized as a promising one, it was not used on a large scale because of the inconvenience of the gaseous Cl. A method based on the use of CCl_4 was developed and used for producing several tons of high purity material for nuclear applications. As raw material, Be containing not more than 0.006% heavy metal impurities was used in briquetted form; technical CCl_4 filtered through glass fibers served as chlorinating agent. The reaction yielded best results when carried out at 650 to 700°C, introducing the CCl_4 at a rate of 2.5 kg/min per m^2 of furnace cross section. The $BeCl_2$ obtained was melted with NaCl and was electrolyzed at 320−340°C in a Ni crucible using a graphite anode and a Ni cathode. The Be deposits in form of brilliant dendritic crystals. The large crystals contained 99.966, the small ones 99.937% Be. The Be yield including treatment of the residues was 96%, the current yield more than 80%. The chloride method may successfully compete with the process based on the reduction of BeF_2 and yields a product with higher purity. (TTT)

2124 TRANSACTIONS OF THE VACUUM METALLURGY CONFERENCE, 1960. Rointan F. Bunshah, ed. New York, Interscience Publishers, 1961. 358p.

Twenty-four papers are included; separate abstracts have been prepared for six. The following topics are included: vacuum arcs, arc melting, casting, induction melting, degassing, vacuum products, applications of electron beam techniques, vacuum furnaces, and vacuum effects on properties of various materials. These topics are discussed in terms of new research and advanced engineering developments. (N.W.R.)

2125 PRECISION CONTROL OF BORON-10 ISOTOPE IN A MODIFIED TYPE 304 STAINLESS STEEL. Marlin S. Walmer (Hamilton Watch Co., Lancaster, Penna.). p.131-42 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

In order to produce stainless steel containing controlled amounts of the B^{10} isotope, it is necessary to have precise information on the boron content of elemental boron to be used; boron content of raw materials, which may be present in trace amounts; and isotopic ratio of natural boron and enriched boron. These factors must be taken into consideration when calculating the heat. Proper evaluation of the analytical results requires that the B^{10}/B^T isotopic ratio of the product also be known. Micro-examination can be used to determine the extent of surface deboronization which occurs during hot processing in an oxidizing atmosphere. The boron deficient surface can be removed by machining or grinding. (N.W.R.)

2126 PRECISION CONTROL OF BORON-10 ISOTOPE ANALYSIS IN A MODIFIED 304 STAINLESS STEEL. Pierre P. Turillon and Harold B. Canada (Kelsey-Hayes Co., New Hartford, N. Y.). p.143-9 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

The vacuum-induction melting of a type AISI 304 stainless steel permits the melting of very reliable products, because of the following advantages: close control of chemical composition; optimum refining of the metal with respect to detrimental tramp elements; complete removal of gases such as oxygen, hydrogen, and nitrogen which have detrimental effects on mechanical properties; and complete homogeneity of the metal even for such light and reactive elements as boron, which are usually difficult to distribute evenly. By applying the vacuum induction process, a maximum deviation of 0.02% B^{10} is obtained in the type AISI 304 stainless steel ingots containing 0.37% B^{10}. (N.W.R.)

2127 THE ZONE PURIFICATION OF YTTRIUM. William C. Necker (General Electric Co., Cincinnati). p.289-98 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

A description is given of the zone refining process and the equipment necessary for the process such as the floating zone refining rig with the vacuum envelope. Zone refining is a process that will work on any crystalline substance that can be safely melted and that exhibits a difference between the concentrations of impurities in the liquid and in the freezing-solid states. After yttrium has made the necessary passes through the zone refining rig, it is found that the process has little or no effect on gaseous impurities, but that metallic impurities are reduced. Changes in physical properties are also indicated by a difference in the expected cold reduction (35 to 40% for nonprocessed material to more than 55% for processed material). (N.W.R.)

2128 THE ROLE OF VACUUM METALLURGY IN THE CONSOLIDATION OF SOME ZIRCONIUM-RARE EARTH ALLOYS. L. Ianniello and D. Lam (Rensselaer Polytechnic Inst., Troy, N. Y.). p.299-312 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

The production methods and problems encountered in making binary alloys of zirconium with dysprosium, erbium, holium, neodymium, and yttrium are described. The processing of the alloys must be carried out under controlled atmosphere conditions because of the reactive nature of the elements. The nonconsumable tungsten electrode vacuum-arc melting method is shown to be successful for producing the alloys with a minimum of contamination due to copper and tungsten. The recovery of the rare earths in the alloys is shown to be related to the heat of sublimation of the elements. The relative strengthening effect of the various elements on zirconium is indicative of their relative solubilities in zirconium. The production of zone leveled alloys is also shown to be feasible and offers the best method for the avoidance of contamination during melting. (N.W.R.)

2129 PROCESS OF TREATING CARBON ARTICLES. Robert Lewis Bickerdike, Anthony Reginald George Brown, and William Watt (to United Kingdom Atomic Energy Authority). British Patent 881,404. Nov. 1, 1961.

A process is outlined for treating a porous carbon article to render it substantially impermeable. The process comprises heating the article in a moving stream of a gaseous carbon compound at a steady temperature in the range 500 to 1500°C to cause pyrolytic deposition of a carbon coating on the surface of the article. The conditions of this treatment are controlled to prevent soot deposition and according to whether the carbon deposition is to be in the pores or on the surface of the article. (D.L.C.)

2130 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF GRAPHITE. Michael Stuart Thomas Price (to United Kingdom Atomic Energy Authority). British Patent 883,021. Nov. 22, 1961.

A method is given for producing graphite of increased density compared with graphite made by conventional methods from mixtures of coke particles and pitch. The method comprises the steps of forming an intimate mixture of artificial graphite powder (dia. less than 300 μ) and fine carbon black (average dia. = 0.3 μ) in a 2 to 1 or 3 to 2 proportion, incorporating the mixture into ~20% of a carbonizable binder, e.g., tar pitch or furfuryl alcohol, shaping the plastic mass, baking the mass to convert the binder to carbon, and graphitizing the baked mass. (D.L.C.)

Corrosion

2131 (AAEC/E-71) OXIDATION OF 1% Cr, 0.5% Mo STEEL IN CARBON DIOXIDE. A. Draycott and R. W. Hubery (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1961. 34p.

The corrosion of a 1% Cr, 0.5% Mo steel in carbon dioxide was measured over the range 450 to 525°C under varying conditions of surface preparation, pressure, velocity, and impurity content of the gas. Weight changes were measured as a function of time of exposure in tests of up to 4000 hr. It was found that surface preparation of the specimens and pressure of the gas have little effect on the rate of oxidation of this steel in CO_2. Also presence of moisture up to 20000 ppm does not materially alter the rate of attack. Weight-gains of specimens in pure oxygen were always found to be less than weight-gains obtained in carbon dioxide under identical conditions of temperature, pressure, and moisture content. Scaling of the oxide layer was never encountered under static or semi-static conditions. However, scaling occurred on many specimens exposed in flowing gas; the extent depended on the temperature and gas velocity. Metallographic examination verified that a protective Cr_2O_3 film was never likely to be formed on this steel under the conditions of the tests. The major products of the reaction were Fe_3O_4 and another unidentified spinel. This study has shown that it is not safe to recommend this steel for use in carbon dioxide cooled reactors at temperatures above 450°C. (auth)

2132 (ANL-6434) ELECTRICAL MEASUREMENTS ON THE GROWING SCALE ON ZIRCONIUM—TITANIUM ALLOYS. R. D. Misch and G. W. Iseler (Argonne National Lab., Ill.). Work completed 1960. Oct. 1961. Contract W-31-109-eng-38. 27p.

The corrosion rates of low-titanium zirconium alloys increased with titanium content when exposed to water at 290°C or to 1 atm oxygen at 290, 350, 400, and 500°C. The scaling rate reached a maximum (approximately 3000 mg/dm^2 for 3-hr exposure) at 15 at.% Ti in 1-atm oxygen at 500°C and then decreased with increasing titanium content. Under the same conditions, pure zirconium and titanium had much lower weight gains, 10 and 4 mg/dm^2, respectively. In oxygen at 500°C, the oxidation rate law was initially cubic or parabolic for alloys containing 3.75, 15.0, and 50.0 at.% Ti, and then changed to approximately a linear one. The transition times were 17, 7, and 54 min for the 3.75, 15.0, and 50.0 at.% Ti alloys, respectively. Transition in the rate law and the rise in EMF and resistance appeared to be independent variables. The electrical changes were attributed to changes in defect structure, and the rate law transitions were attributed to structural changes. The results provided an explanation for the maximum oxidation rate at 15 at.% Ti and for the differences in the influence of additives on the corrosion rates of zirconium and titanium in high temperature water. The EMF of the corrosion cell consisting of [alloy|oxide|O_2] was a function of the resistance of the oxide layer. The 3.75 and 15.0 at.% Ti alloys had small EMF's and resistances initially, but EMF and resistance increased appreciably and rapidly at times after the transition stage. The 50 at.% Ti alloy had a very small EMF which was relatively constant while the resistance showed a slight increase with time. (auth)

2133 (DMIC-158) STRESS-CORROSION CRACKING OF HIGH-STRENGTH STAINLESS STEELS IN ATMOSPHERIC ENVIRONMENTS. C. J. Slunder (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 15, 1961. 38p. Contract AF33(616)-7747.

Available information on the stress-corrosion cracking of the high-strength stainless steels is tabulated and discussed. Data are included for austenitic, martensitic, martensitic precipitation-hardenable, and semiaustenitic precipitation-hardenable grades. Some tentative guidelines are indicated. Stress-corrosion cracking appears to be strongly influenced by prior thermal history. (auth)

2134 (NP-10966) ANALYSE DE L'EVOLUTION DE LA STRUCTURE DES GRAPHITES NUCLEAIRES, DUE DE LA CORROSION GAZEUSE, AU MOYEN D'INJECTION SOUS PRESSION D'ARGENT FONDU. (Analysis of the Change of Structure of Nuclear Graphites Due to Gaseous Corrosion by Injection of Molten Silver under Pressure). P. Magnier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Oct. 24, 1960. 26p. (DPC/PCA/60-941).

Nuclear graphite was impregnated with molten silver in order to clarify certain aspects of the kinetics of the gas/graphite reaction, which seems to be bonded to the structure of the solid fissures. In trying to vary the pressure of impregnation, it was possible to study several types of fissures, which were revealed later by eliminating the carbon almost entirely by incineration and by performing x radiography. It was found that pressures of 3 × 6 kg per cm^2 were sufficient to explore the principle fissures. The microscopic examination of the skeleton obtained by incineration revealed, under molds of extended cones and of variable division along the graphite, some hot spots distributed on the surface of the silver filaments. These are comparable to the impurities already discovered by x radiography. (tr-auth)

2135 (NP-10977) ETUDE CINETIQUE DE LA PHASE INITIALE DE L'OXYDATION DU GRAPHITE NUCLEAIRE (TYPE G_2-G_3) PAR LE GAZ CARBONIQUE. (Study of the Kinetics of the Initial Phase of Oxidation of Nuclear Graphite (Type G_2-G_3) by Carbon Dioxide). C. Clavaud, B. Giraudel, S. Keraudy, and S. May (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Nov. 22, 1960. 26p. (DPC/PCA/60-1033)

The kinetics of the reaction of nuclear graphite G_2-G_3 with CO_2 were studied in the temperature range 750 to 930°C. It was verified that traces of oxygen in CO_2 increase the rate of total oxidation, and that traces of water seem to have little influence. However, larger quantities of water (200 ppm) give an inhibiting effect. A lack of reproducibility in combustion experiments and large variations of rates under identical conditions, probable due to the heterogeneity of solid impurities in the graphite, were observed. However, an activation energy of 56 kcal/mole was determined. (tr-auth)

2136 (ORNL-2833) CORROSION ASSOCIATED WITH HYDROFLUORINATION IN THE OAK RIDGE NATIONAL LABORATORY FLUORIDE VOLATILITY PROCESS. A. E. Goldman and A. P. Litman (Oak Ridge National Lab., Tenn.). Nov. 15, 1961. Contract W-7405-eng-26. 86p.

Studies carried out on corrosion associated with the hydrofluorination-dissolution phase in the fused-salt Fluoride Volatility Process are summarized. Corrosion of hydrofluorination-dissolver vessels used in bench-scale and semiworks-scale process development at ORNL is discussed. The results of a study on construction materials for the dissolution phase are presented. Corrosion studies at ANL are described for comparison purposes. A full-size hydrofluorinator dissolver is described. (M.C.G.)

2137 (AEC-tr-4878) ALUMINUM CORROSION IN WATER-COOLED REACTORS. K. H. Buob and E. Schenker. Translated for Oak Ridge National Lab., Tenn. from Neue Tech., 3: 288-95(1961). 24p. (Includes original, 8p.).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 26504.

2138 (SCL-T-376) INVESTIGATION OF THE CORROSIVE AND ELECTROCHEMICAL BEHAVIOR OF 12 × M STEEL IN WATER AT A HIGH TEMPERATURE. V. V. Gerasimov and A. I. Gromova (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscos). Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Issledovanie Korrozionnogo i Elektrokhimicheskogo Povedeniya Stali 12 × M v Vode pri Vysokoi Temperature." 1960. 24p.

Studies were carried out on the corrosion and the kinetics of electrode processes of low-alloy steel type 12 × M in water containing air, oxygen, hydrogen, or hydrazine at high temperatures and pressures. The results show that the corrosion of 12 × M steel is of an electrochemical nature. The cathode process rate is determined by oxygen diffusion to the metal surface, and the dissolution rate as a function of the potential is expressed for all the media by one anodic polarization curve. The corrosion is increased with oxygen content increase in the water. The corrosion of 12 × M steel in water containing hydrogen or hydrazine is uniform and even, whereas in water containing oxygen or air, the corrosion has a pitted appearance. The corrosion rate diminishes with time and, for water containing some hydrazine, is expressed by the equation $\log K$ (kg/m^2/day = $1.35 - 0.74 \log T$ (hr). (D.L.C.)

2139 THE KINETICS OF OXIDATION AND NITRIDATION OF LITHIUM, CALCIUM, STRONTIUM, AND BARIUM. M. S. Chandrasekharaiah and John L. Margrave (Univ. of Wisconsin, Madison). J. Electrochem. Soc., 108: 1008-12(Nov. 1961).

Reaction rates for lithium, calcium, strontium, and barium during 50 to 120 min of exposure to O_2 or N_2 were measured as a function of temperature and pressure by a manometric method. Many of the reaction rates were found to be exponential functions of time, but in some cases a linear rate law was found. (auth)

2140 NOTES ON THE BEHAVIOR OF CARBON-STEEL IN MELTED LITHIUM AT DIFFERENT TEMPERATURES. P. Spinedi and U. Bernabai (Università, Rome). Met. ital., 53: 505-8(Sept. 1961). (In Italian)

The behavior of a plain carbon steel in contact with molten lithium at temperatures from 700 to 1000°C during various periods is considered. The following two facts are emphasized: the existence of a critical temperature at which the phenomenon of intergranular penetration and attack is particularly intense; considerable increase in the size of ferritic grains after the selective removal of pearlitic carbon by molten lithium, at temperatures ranging from 750 to 900°C. Furthermore, the possibility is envisaged of using lithium as a reagent suitable for evidencing some aspects of re-crystallization. This is in connection with the property shown by lithium of visualizing the defective state at the boundaries of grains and inside of the same. (auth)

2141 KORROZIYA REAKTORNYKH MATERIALOV. (Corrosion of Reactor Materials). V. V. Gerasimov, ed. Moscow, Atomizdat, 1960. 284p.

The symposium includes 29 articles on the influence of stress, temperature, and water on corrosion processes in stainless steel. Electrochemical corrosion and the effects of water composition, stress and heat treatment on the intercrystalline structure of various steels are analyzed. The behavior of austenitic stainless steel, low-alloyed steel, zirconium alloys, and other reactor materials is studied. The effects of cavitation or contact with other material on corrosion processes are discussed. (R.V.J.)

Fabrication

2142 (AD-256167) TITANIUM SHEET ROLLING PROGRAM FOR Ti−8Al−1Mo−1V, Ti−5Al−5Sn−5Zr, AND Ti−7Al−12Zr. Bimonthly Report No. 6, May 1–June 30, 1960. D. L. Day, D. R. Mitchell, and H. D. Kessler (Titanium Metals Corp. of America, Toronto, Ohio). Mar. 30, 1961. Contract NOas 59-6227-c. 47p.

Additional creep-stability tests and chemical analyses performed on Ti−8Al−1Mo−1V sheet mill annealed at 1350°F for 8 hr showed that the substandard creep resistance at 1000°F is associated with the lower annealing temperature. Evaluation of welded Ti−8Al−1Mo−1V was completed which demonstrated that this alloy has good mechanical properties at subzero temperatures. Crack propagation studies of this alloy are also reported. Slab samples from the first two heats of Ti−5Al−5Sn−5Zr and Ti−7Al−12Zr were examined macrographically and analyzed chemically; some variation in Zr content was found throughout the ingots. (D.L.C.)

2143 (AD-256168) TITANIUM SHEET ROLLING PROGRAM FOR Ti−8Al−1Mo−1V, Ti−5Al−5Sn−5Zr, AND Ti−7Al−12Zr. Bimonthly Report No. 7, July 1–August 31, 1960. D. L. Day and H. D. Kessler (Titanium Metals Corp. of America, Toronto, Ohio). Apr. 10, 1961. Contract NOas 59-6227-c. 16p.

Preliminary tensile and bend tests were made on sheets of Ti−5Al−5Sn−5Zr and Ti−7Al−12Zr, and the results show that good mill annealed strength and ductility levels were achieved in both alloys. Slabs from five Ti−8Al−1Mo−1V ingots were chemically analyzed. (D.L.C.)

2144 (ANL-6393) THE EFFECT OF MANGANESE AND SILICON CONTENT ON THE HOT WORKABILITY OF TYPE 304 STAINLESS STEEL CONTAINING 2 w/o BORON. L. C. Hymes and N. Balai (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 12p.

Increased hot workability of Type 304 stainless steel containing approximately 2 wt % boron was obtained by maintaining the manganese and silicon contents of the alloy above minimum levels of 1.40 and 0.60 wt %, respectively. Close control of the range of temperatures over which hot working was carried out was also demonstrated to be of importance. However, over the range investigated variation in the temperature of hot working was of secondary significance as compared with alloy composition. (auth)

2145 (CEND-80) A PROGRAM TO STUDY THE FEASIBILITY OF AND DEVELOP AN APPARATUS FOR THE ULTRASONIC ROLL BONDING OF FUEL PLATES. Progress Report, October 1, 1959–December 31, 1959. R. K. Steele (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Changed from OFFICIAL USE ONLY, Oct. 19, 1961. Contract AT(30-1)-2379. 11p. (NYO-9016)

With this is bound: FEASIBILITY STUDY FOR ULTRASONIC ROLL-BONDING OF FLAT PLATE FUEL ELEMENTS. Quarterly Progress Report No. 2, September 16, 1959–December 15, 1959. (Aeroprojects, Inc., West Chester, Penna.). Sub-Contract No. 1. 18p.

The width of individual bonding bands was increased to 0.1 in. and the correlation of weldability data with the roll bonding work was begun. Surface finish of the bond specimen was improved. A high speed bonder and transducer system were nearly completed. The first edge bonds were made and demonstrated feasibility of the approach. Shot blasting and stud-weld tensile testing were applied effectively in the testing of face bonded specimens. The metallographic techniques suggested a concentration of ultrasonic working effects in the clad. Grain growth across the ultrasonic bond interface was stimulated by high temperature annealing indicating that true metal-to-metal contact is achieved during bonding although high oxide concentrations inhibit growth at lower temperatures. Arrangements were made for ultrasonic inspection of face bonds. The ultrasonic weldability of aluminum cladding alloys was determined, and studies with stainless steel were started. Data were obtained with an ultrasonic roller-table welder that produced continuous seam-type bonds about 0.100-in. wide. These data were correlated with exploratory results previously obtained on alumium that was bonded with an ultrasonic roller-type welder which was used as a spot-type welder. Problems associated with ultrasonic high-speed roller cladding of aluminum were investigated. Studies to optimize welding seam (bond band) width and spacing were undertaken. The surface finish of the cladding was improved. Techniques for evaluating strengths of bond bands were devised and appraised. Equipment, to increase weld-cladding rates, was designed and fabricated and roller disks with expected longer service life are being fabricated. A drybox, in which ultrasonic weld-cladding will be carried out in a controlled atmosphere, was designed and is being manufactured. Fixtures were designed to provide positioning stability of the core during edge bonding as one approach to the problem of edge cladding. Fabrication of the 5000-watt, high-power ultrasonic roller welder, that will be needed in future studies, is about 60% complete. Ultrasonic weld-clad techniques, for continuous bond band cladding of aluminum to the sides of simulated flat fuel element cores, are being improved. Surface finish of the cladding does not appear to be as serious a problem as originally anticipated. It is anticipated that larger bond bands can be made by increasing roller-disk radius. Preliminary data indicated that a drum-type peel test will provide bond strength data which may be reliable and can be correlated with ultrasonic bonding parameters. (auth)

2146 (CRCE-716(Pt.V)) PREPARATION OF URANIUM DIOXIDE FOR USE IN CERAMIC FUELS. PART V. THE ENRICHED URANIUM DIOXIDE PLANT. W. T. Bourns and L. C. Watson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 13, 1961. Reprinted Aug. 1961. 70p. (CEI-114; AECL-1312).

A description is given of the pilot-plant-sized apparatus built at Chalk River for the production of UO_2 enriched in U^{235}. The experimental work that led to a method for producing UO_2 with sintered density of 10.56 ± 0.09 g/cm^3 is outlined. Polished sections of sintered pellets made from this UO_2 show the preferred microstructure. (auth)

2147 (NAA-SR-6453) SEMI-CONTINUOUS HOT PRESSING. J. D. McClelland and E. H. Zehms (Atomics

International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1961. Contract AT-11-1-GEN-8. 14p.

Equipment and techniques used in the semi-continuous hot pressing are described. Preliminary data are presented on the effect of time and temperature on the final density of high-purity beryllia. Densities of greater than 98% were achieved, at temperatures as low as 1100°C, and at time cycles as short as 11 min. The conclusion was reached that, under suitable conditions, semi-continuous hot pressing can compete both technically and economically with sintering techniques. (auth)

2148 (NP-11044) TUNGSTEN EXTRUSION PROGRAM. Second Interim Technical Report, April 10, 1961–August 24, 1961. (Wah Chang Corp., Albany, Ore.). Contract AF33(600)-42395. 77p.

Several evaluation ingots of W–3% Mo were arc-melted utilizing various electrode preparation techniques, melt rates, and crucible sizes in an attempt to optimize as-cast ingot quality. These ingots were evaluated for purity, soundness, structure, and sidewall cleanup. In addition, several significant equipment modifications were made as a result of the melt studies during the development phase. Preliminary extrusions were made with two 6.55-in. dia. billets at 2.8 : 1 reduction ratio and also 3.725-in. dia. billets at 11 : 1 and 17 : 1 reduction ratios. Extrusion equipment and accessory tooling are discussed in detail. (auth)

2149 (OEL-MET-3306) INVESTIGATION OF THE PRESSURE BONDING OF ZIRCALOY-2 TO STAINLESS STEEL BY INDENTATION. (Orenda Engines Ltd., Malton, Ont.). June 1961. Contract CR10D6389. 31p. (AECL-1306)

Factors governing pressure bonding were investigated with a series of tests at room temperature and at 500°F using $\frac{1}{8}$-in. thick sheet material. The test assemblies consisted of Zircaloy-2 sheet, annealed or cold worked and autoclaved, and either Type-410 Stainless Steel, hardened and tempered, or Type-304 Stainless Steel, annealed. The investigation included a limited study of various surface preparations and the effect of specimen geometry on the bonding process. A number of bonded samples were subjected to thermal cycling and to diffusion heat treatments. The investigation showed that Zircaloy-2 can be consistently bonded to Stainless Steel if the faying surfaces are carefully prepared and a certain minimum deformation is produced in the parent metals. The strength of the pressure bonded sheet assemblies was controlled by the thickness of the parent metals immediately adjacent to the bonded area. (auth)

2150 (ORNL-TM-40) FABRICATION OF BOILER SECTION FOR BOILING-LIQUID-METAL LOOP. E. A. Franco-Ferreira (Oak Ridge National Lab., Tenn.). Oct. 16, 1961. Contract [W-7405-eng-26]. 16p.

A 4-ft-long boiler was successfully fabricated for a boiling-liquid-metal loop. This involved brazing massive copper blocks between a thin-walled stainless steel tube and a thin-gage stainless steel jacket. Essentially 100% bonding to the tube was required while a few areas of non-bond were permitted in the copper-to-jacket braze. The brazing was accomplished in vacuum, using an electroless-deposited nickel-phosphorus alloy and slurry-deposited nickel-chromium–phosphorus alloy. Bonding was better than 99% complete in the copper-to-tube braze and was approx 92% complete in the copper-to-jacket braze. (auth)

2151 (WAL-624.5/1) HIGH ENERGY FORMING OF METALLIC SHEET MATERIALS RYAN REPORT 61B072. D. S. Adams, V. S. Harrison, and J. P. Orr (Ryan Aeronautical Co., Lindberg Field, San Diego, Calif.). Feb. 1961. Contract DA-04-495-ORD-1921. 46p.

Explosive forming tests were made on 5086 and 7075 aluminum alloys; Type 301 and 302 stainless steel; 6Al–4V titanium alloy; AM355 PH steel; and 4340 low alloy steel. (auth)

2152 (NP-tr-755) CHARACTERISTICS OF EXTRUDING METAL BY HIGH-PRESSURE LIQUID AT ELEVATED TEMPERATURES. V. I. Beresnev, D. K. Bulychev, and K. P. Rodionov. Translated from Fiz. Metal. i Metalloved., 11: 115-22(1961). 13p.

A review is presented of investigations of the hydraulic extrusion of metals at elevated temperatures, which permit the characterization of the process as a highly-efficient method of pressure treating metals, a method having substantial advantages over the ram-extrusion method widely used in modern industry. The method can considerably reduce the force required to deform metals and thus indicates one of the possible methods of solving the problem of working hard-to-deform metals by high-pressure liquids. Mechanisms are considered for the effect of the working medium on the extrusion conditions of the metal during heating. (B.O.G.)

2153 ELECTRON-BEAM WELDING. Aircraft Production, 23: 303-7(Aug. 1961).

Electron-beam welding, a fusion-welding process that joins two or more pieces of metal by local melting, thus producing coalescence, is described. Elements of equipment, control, supply equipment, and methods of operation are described. Photographs and a table of weld settings are included. Uses are indicated. (L.N.N.)

2154 SOME SPECIAL APPLICATIONS OF WELDING IN STEAM, GAS TURBINE, AND NUCLEAR POWER PLANTS. J. M. Robertson (C. A. Parsons and Co. Ltd., Newcastle-Upon-Tyne, Eng.). Brit. Welding J., 8: 463-72 (Oct. 1961).

Six special applications of welding in steam, gas-turbine, and nuclear power plants are described. Experiences are quoted of: the welding of austenitic steel gas-turbine rotors; the butt welding of heat-exchanger tubes in dissimilar metals; the welding of steam pipes for advanced steam conditions; welding in relation to feed-water heaters; the construction of expansion bellows in alloy steels; and the attachment of fins to heat-exchanger tubes. (auth)

2155 A NOTE ON THE WELDING BEHAVIOUR OF NIOBIUM AND VANADIUM. R. D. Johnston and L. W. Derry (Battersea Coll. of Tech., London). Brit. Welding J., 8: 511-13(Nov. 1961).

A preliminary explanation is given for a phenomenon experienced in the welding of Nb sheet to V sheet. The weld-parent metal interfaces are in the form of long tongues, and the shape is affected by the welding current and traverse speeds. The effect is thought to be due to the dissolution of Nb in molten V, but further work is being carried out to determine the influence of alloying properties as indicated by phase equilibrium diagrams. (auth)

2156 SWAGE COMPACTION OF CERAMICS. UNIQUE FABRICATION TECHNIQUE UTILIZED TO ADVANTAGE IN PRODUCTION OF UO_2 FUEL ELEMENTS. J. E. Brown (General Electric Co., Richland, Wash.). Ceram. Age, 75: No. 1, 20-4(Jan. 1960). (HW-SA-1800)

Swage compaction of ceramic fuel elements is described and the production of uranium dioxide fuel elements by this method is given as an example. The method consists of filling a fuel rod with granular uranium dioxide, partially compacting the material by vibrating the container as it is filled, and reducing the cross-sectional area of the container by swaging until maximum uranium dioxide density is achieved. The equipment used is also described. (N.W.R.)

2157 STUDIES ON SINTERING OF BERYLLIUM POWDER. III. ON THE PRETREATMENT OF BERYLLIUM POWDER FOR SINTERING. Hiroshi Nakatani. Denki Shikensho Ihô, 25: 605-10(Aug. 1961). (In Japanese)

The pretreatment of beryllium powder for sintering was studied. Using ethylene dibromide—benzole mixed solution, a method of separation by specific gravity was carried out to separate the impurities mixed in the process of mechanically reducing the fused salt electrolytic flakes or the particle control process. In order to refine the particle surface, concentrated nitric acid was used. Spectral analysis of this pretreated powder showed effective results when compared with the reduced powder. (auth)

2158 STRUCTURAL URANIUM ALLOY MELTING, CASTING AND HEAT TREATING TECHNIQUES. G. D. Chandley and D. G. Fleck (Watertown Arsenal, Mass.). Modern Castings, 40: No. 2, 56-64(Aug. 1961).

High strength uranium-base alloys are becoming more important in construction of nuclear and non-nuclear weapons. The various techniques for handling these uranium alloys are described in detail. (auth)

2159 PROGRESS IN POWDER METALLURGY. VOLUME SEVENTEEN. Proceedings of the Seventeenth Annual Technical Meeting of the Metal Powder Industries Federation, Cleveland, Ohio, April 24, 25, 26, 1961. New York, Metal Powder Industries Federation, 1961. 195p. $12.00.

Seventeen papers are included on powder metallurgy techniques and properties. The papers cover such topics as compaction, sintering, and fabrication techniques. (N.W.R.)

2160 THE EFFECT OF FURNACE PRESSURE ON URANIUM INGOT CHEMISTRY AND METAL QUALITY. R. B. Steck, H. M. Eikenberry, and D. Detrou (National Lead Co. of Ohio, Cincinnati). p.109-17 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

The effect of pressure in the vacuum-induction remelt furnaces upon uranium ingot chemistry and metal quality is described. The data are evaluated by the analysis-of-variance technique and the evaluation includes the effects of pressure on hydrogen, oxygen, nitrogen, carbon, and slug-to-good slug yields. The results show that the lower pressures improve the metal quality by removing gaseous contaminants from the molten metal. The higher furnace operating pressures (350 mm Hg) result in higher hydrogen and nitrogen contents and lower carbon content and slug-to-good slug yields. Also, nitrogen and carbon segregation occurred in the cast ingots. The nitrogen content at the top center of the ingot is extremely low; the carbon content at the top of the ingot is low. (N.W.R.)

2161 NEW DEVELOPMENT IN THE VACUUM MELTING AND CASTING OF URANIUM IN TONNAGE QUANTITIES. H. M. Eikenberry, J. W. Mahaffey, and R. B. Steck (National Lead Co. of Ohio, Cincinnati). p.101-8 of "Transactions of the Vacuum Metallurgy Conference, 1960." New York, Interscience Publishers, 1961.

Developments which have improved fuel core quality and reduced production costs are described. These developments in the melting and casting of uranium ingots are: modification of the crucible and knockout-slide assembly, substitution of uncoated crucibles for coated crucibles, and substitution of a one-piece gun barrel mold for a vertically split mold. (N.W.R.)

2162 IMPROVEMENTS IN OR RELATING TO PRODUCTION OF URANIUM OXIDE BODIES. Henry Lloyd, Neville Ronald Williams, and Christopher Cameron Hope Wheatley (to United Kingdom Atomic Energy Authority). British Patent 881,883. Nov. 8, 1961.

A method is outlined for producing a nonstoichiometric UO_2 body suitable for sintering to yield a high-density UO_2 body. The method comprises cold-compacting a mixture of stoichiometric or nonstoichiometric UO_2 powder and an organic binding agent, and heating the mixture to 200 to 250°C in an oxidizing atmosphere until the ratio of O atoms to U atoms in the mixture is at least 2.3. The binding agent is preferably plasticized polybutyl methacrylate. (D. L.C.)

Properties and Structure

2163 (AAEC/E-70) STUDIES OF URANIUM—SODIUM SUSPENSIONS. PART 2. HYDRODYNAMIC, METALLURGICAL, AND MECHANICAL EFFECTS: GENERAL CONCLUSIONS. F. L. Bett, R. J. Hilditch, R. G. Mepham, and P. A. Gillespie (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1961. 59p.

Hydrodynamic behavior of a 0.76 at. % uranium—sodium suspension is explored for velocities up to 8.3 ft/sec and temperatures up to 625°C. The influence of velocity and temperature on suspension behavior is described. Mechanical and metallurgical effects associated with circulation in an austenitic stainless steel loop in contact with beryllium are listed. The behavior of the suspension is explained in terms of hindered settling theory. A reactor loop model illustrating possible use of the uranium—sodium suspension as a reactor fuel/coolant is presented and recommendations for further work are given. (auth)

2164 (AD-256389) RESEARCH ON PHASE EQUILIBRIA BETWEEN BORON OXIDES AND REFRACTORY OXIDES, INCLUDING SILICON AND ALUMINUM OXIDES. Quarterly Progress Report No. 7, January 1, 1961—March 31, 1961. P. J. Gielisse, T. J. Rockett, and W. R. Foster (Ohio State Univ. Research Foundation, Columbus). Apr. 5, 1961. Contract AF33(616)-6509. 17p.

Crystallites were used to locate the liquidus curve for the $B_2O_3-SiO_2$ system; some of the difficulties encountered, e.g., hydration, are described. X-ray patterns of $B-SiO_2$ mixtures fired at 1400°C revealed some new phases in addition to phases Si or Si + SiB_6. Observations of B_7O-SiO_2 firings in an Al_2O_3 boat are reported. Hypothetical isothermal diagrams are presented for the B—Si—O system for the temperatures 1000, 1200, and 1400°C. (D.L.C.)

2165 (AFOSR-1226) DIFFUSION OF GASES IN HAFNIUM. E. Bisogni and C. Wert (Illinois. Univ., Urbana). Aug. 2, 1961. Contract AF49(638)-672. 25p.

The internal friction of Hf, containing either O_2 or N_2 as an interstitial impurity, is measured at temperatures of 300 to 700°C. The effects of impurity concentration are investigated. Snoek-type peaks are observed in the internal friction curves; a mechanism is suggested to explain the presence of these peaks. (T.F.H.)

2166 (AGN-8039) RUBIDIUM AND CESIUM EVALUATION PROGRAM. Report No. 2. Quarterly Technical Report, May 1—July 31, 1961. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 33p.

Work is being performed to provide materials compatibility and physical and thermodynamic data on rubidium and cesium metals at elevated temperatures. Equipment was constructed and installed in the rubidium corrosion capsule program. Helium leak testing of all capsules was completed. Rubidium was purified and analysis for oxygen was carried out. A Nb–1% Zr alloy was selected for fabrication of a pumped loop for testing of a suitable containment material for cesium liquid and vapor under dynamic conditions at high temperatures. The design modifications made in the loop are outlined. A study of the various possible methods of measuring the density of liquid cesium from its melting point to 1800°F was undertaken. (M.C.G.)

2167 (ARF-2210-5) IMPROVED VANADIUM-BASE ALLOYS. Bimonthly Report No. 5, August 1, 1961–September 30, 1961. B. R. Rajala and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 26, 1961. Contract NOw 61-0417-c. 14p.

Vanadium-base alloys were evaluated at temperatures up to 2000°F. Carbon, added to the V-5 wt % Ti-20 wt % Nb base in amounts of 0.03 to 0.25 wt %, was most effective in improving the stress-rupture life at the 0.05 wt % level. A similar carbon addition to the V-1 wt % Ti-60 wt % Nb base also improved the long-time strength properties; failure occurred in 27 hr under 10,000 psi at 2000°F. Specimens of V-5 wt % Ti-20 wt % Nb, prepared with melting stock of varying impurity content, exhibited large variations in 2000°F ultimate tensile strength values. Smaller strength variations were noted in the same sheet stock when tested under vacuum or in helium containing traces of atmospheric impurities. Initial results indicated that reduction of interstitials caused decreased strength. (auth)

2168 (ARF-2227-2) HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Bimonthly Report No. 2, August 12, 1961–October 11, 1961. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 6, 1961. Contract NOw-61-0806-c. 15p.

Several types of coatings are being investigated for the protection of vanadium-base alloys in air at 2000°F or above. A specimen of V–1 wt % Ti–60 wt % Nb, siliconized by pack-cementation, withstood exposure to 2000°F air for 500 hours without evidence of failure or hardening of the alloy base. At 2200°F, a similar coating failed at a corner in 16.5 hours, although the remainder of the coating afforded good protection. Small quantities of yttria were found to produce a substantial increase in the melting point of V_2O_5, and the oxide mixture offered short-time protection to the vanadium alloy base at 2000°F. Roll-cladding of 70Fe-25Cr-5Al sheet to V–5 wt % Ti–20 wt % Nb at 2000°F produced a strong bond. Liquid-phase sintered Cr–Au, a fused nickel-chromium base alloy, and flame-sprayed barium titanate afforded protection for short times (0.5 to 1 hour) at 2000°F. (auth)

2169 (BLG-62) WIGNER ENERGY STORAGE IN FISSION PRODUCT DAMAGED GRAPHITE. A. H. Willis, J. M. Baugnet, and R. C. De Beukelaer (Brussels. Centre d'Etude de l'Energie Nucleaire). June 28, 1961. 16p.

An experiment is described which shows that fission fragments can give rise to large Wigner energy storage in irradiated graphite. An exposure of 1.3×10^{18} nvt (thermal) at 32°C resulted in 31.2 ± 3.1 cal/g of stored energy in a sample containing 0.0332 g of U^{235} per cc of graphite whose specific gravity was 1.75 ± 0.04. No rise in sample temperature occurred during irradiation although a measurable change would have been expected for this level of stored energy. (auth)

2170 (BM-RI-5872) EFFECTS OF INTERSTITIAL IMPURITY LEVELS ON MECHANICAL PROPERTIES OF COLUMBIUM AT LOW TEMPERATURES. M. D. Carver, J. T. Dunham, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Feb. 1960. 17p.

The effects of impurity levels on the mechanical properties of niobium at low temperatures were determined. High-purity, electron-bombardment-melted niobium was used as a base material. Variations in impurity levels were obtained by arc-melting charges containing definite amounts of added impurities. Tensile tests were conducted at low temperatures. Results showed the almost pure base metal to be ductile at −194°C, the lower limit of the range used. Ductility of less-pure niobium appeared to depend on interstitial element content. The ductile-to-brittle transition temperature appeared to be raised by increasing the carbon content in the range of 50 to 730 ppm, nitrogen content in the range of 50 to 200 ppm, or total interstitial content in the range of 240 to 1380 ppm. Variations in interstitial levels appeared to have little or no effect on the ultimate strength of columbium in the range of room temperature to −194°C. (auth)

2171 (CRGM-1041) THE BEHAVIOUR OF HYDROGEN IN BERYLLIUM. C. E. Ells and W. Evans (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 11p. (AECL-1347).

Hydrogen has been introduced into samples of several types of beryllium by proton irradiation, and the subsequent behavior of the hydrogen on post-irradiation heating of the samples has been observed by metallographic techniques. The materials used had beryllium oxide contents of 0.1 to 2.2 wt %; the hydrogen content studied was approximately 0.5 cm^3 gas/cm^3 metal. Agglomerates of hydrogen were seen after heating for one hour at temperatures as low as 320°C. Grain boundaries were highly preferred points of nucleation for the agglomerates, and after a sufficiently severe heat treatment, e.g., 1 hour at 1000°C, extensive grain boundary cracking was observed in most of the materials studied. The results can be interpreted qualitatively in terms of observations from other gas metal systems; in particular the behavior of hydrogen in beryllium is very similar to its behavior in aluminum. (auth)

2172 (DMIC-Memo-133) TITANIUM IN AEROSPACE APPLICATIONS. R. I. Jaffee, W. H. Sharp, and R. S. Nycum (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 24, 1961. 58p.

The past and current status of titanium in aeronautical applications, including pertinent design criteria, available titanium products and alternative materials, and fabrication problems are reviewed. Production, titanium alloys, design criteria, properties, and airframe and aerospace applications are discussed. (M.C.G.)

2173 (DMIC-Memo-137) REVIEW OF RECENT DEVELOPMENTS ON OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS. W. D. Klopp (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). [Oct. 1961]. 7p.

Developments are reviewed on oxidation-resistant coatings for niobium, molybdenum, tungsten, tantalum, and their alloys, as reported in information received by DMIC from August through October, 1961. (auth)

2174 (ER-11462-2) EVALUATION OF COATINGS FOR MOLYBDENUM. Bi-Monthly Progress Report No. 2, July 18, 1960–September 17, 1960. Charles R. Wilks, Harry Magalotti, and John V. Mumford (Martin Co., Baltimore). Oct. 10, 1960. Contract NOw-60-0321c. 8p.

Four oxidation-resistant coatings for molybdenum are being evaluated to establish criteria for use in aerospace design. The initial complement of specimens coated with W-2 (Chromalloy) and Al–Si was received for test. Specimens coated by Wall-Colmonoy with Climax Al–Cr–Si were improperly coated and are being replaced. The Lindo LM-5 coating was discontinued and GE System 300 coating is being considered as a replacement. Tests were made to explore the problems associated with resistance heating. Excessive temperature gradients were obtained. Tests with induction heating were more promising and these efforts are continuing. (auth)

2175 (GEMP-3A) HIGH TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 3, PART A, JULY 1, 1961–AUGUST 31, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.) Sept. 15, 1961. Contract AT(40-1)-2847. 35p.

Progress is reported on the following material development programs: metallic fuel element materials for greater than 1200°C operation in oxidizing atmospheres, high-temperature control materials, fabricability of high-temperature structural materials, effect of radiation on high-temperature alloys, moderator fabrication and testing, and high-temperature thermal-insulation development. (N.W.R.)

2176 (GEMP-4A) HIGH TEMPERATURE MATERIALS PROGRAM. Progress Report No. 4, Part A, August 1, 1961–September 30, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Oct. 15, 1961. Contract AT(40-1)-2847. 15p.

Samples of two compositions of BeO plus MgO were placed in the Engineering Test Reactor. Designs for cartridges to be used in 600 and 1000°C irradiations were completed. Sintering conditions were established for preparing rods of the remaining four of the six BeO compositions to be tested. A more precise method of measuring grain size was adopted. Physical property measurements consisted largely of non-destructive tests on both control and irradiation specimens. (M.C.G.)

2177 (GEMP-5A) HIGH TEMPERATURE MATERIALS PROGRAM. Progress Report No. 5, Part A, August 15–October 15, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Nov. 15, 1961. Contract AT(40-1)-2847. 57p.

Work in process on materials development is described. Developments of metallic fuel element materials for greater than 1200°C operation in oxidizing atmospheres, high-temperature control materials, fabricability of high-temperature structural materials, effects of radiation on high-temperature alloys, moderator fabrication and testing, and high-temperature thermal-insulation development are reported. (M.C.G.)

2178 (HW-68608) TRIP REPORT—STATUS OF 17-4 PH AND OTHER PRECIPITATION HARDENING STAINLESS STEELS. S. H. Bush (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 9, 1961. Contract AT(45-1)-1350. 8p.

The status of 17-4 pH stainless steel failures, tests conducted to establish the mechanism, and measures taken to alleviate the problem are reviewed. It was found that in all instances the failed material was subjected to one particular heat treatment. This was aging at 900°F for one hour after solution heat treating one hour at 1900°F. These treatments caused the material to have a hardness of 43 to 45 Rockwell C, to contain a high level of residual stress, and to be essentially in the martensitic state. In this condition the material is very sensitive to stress corrosion cracking. (M.C.G.)

2179 (NAA-SR-6109) PERMEABILITY OF METALS AND ENAMELED METALS TO HYDROGEN. David W. Rudd (Metal Hydrides, Inc., Beverly, Mass.) and J. B. Vetrano (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 30, 1961. Contract AT-11-1-GEN-8. 58p.

The results of tests on permeability of various selected materials to hydrogen are reported. The investigation includes findings on metal, oxide-coated metal, and glass-coated metal systems. Where possible, the results are fitted to the known relationships of diffusion theory. Both the permeability of certain alloys to hydrogen, and the permeability characteristics of various coated-metal membranes are discussed. The alloys include AISI Types-321 and 430 stainless steels and Hastelloy B. The coated metals include calorized AISI-Type 430 stainless steel, four glass-coated AISI-Type 304 stainless steels, and three systems of Hastelloy B coated with a proprietary material furnished by Solar Aircraft Co. Measurements were made using a one-piece diffuser in which the membrane is a flat disc. The range of temperatures investigated was from 550 to 820°C; and the pressures employed, 1.1, 1.5, and 2.0 atm. The metal alloys investigated had permeabilities uniformly much greater than surface-treated metals. As small an amount as 3 to 7 mils of a suitable, high-temperature glass enamel or 10 mils of surface calorizing is still 10 to 100 times more effective as a hydrogen barrier than 60 to 120 mils of untreated steel. (auth)

2180 (NMI-1252) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY: STABILITY OF THE HIGH TEMPERATURE BETA PHASE IN BERYLLIUM AND BERYLLIUM ALLOYS. Final Technical Report, July 1, 1960 through June 30, 1961. J. J. Pickett, E. D. Levine, and W. B. Nowak (Nuclear Metals, Inc., Concord, Mass.). Sept. 11, 1961. 34p.

The discovery of a high-temperature phase in Be opened a new field of study in Be metallurgy. Studies in this field were carried out over the past year. Differential thermal analysis (DTA) to determine equilibrium phase boundaries was applied to alloys of Be in each of the following systems: Ba, Ce, Co, Cu, La, Mn, Pt, Ag, Ni–Co, Ni–Fe, Ni–Cu, Ni–Co–Fe, and Ni–Co–Mn. The boundaries of the beta Be regions in the systems Be–Co and Be–Cu were fairly well established; the remaining systems require further study using additional test methods. The Be–Ni system, studied previously, and the Be–Co and Be–Cu systems enlarge the beta field and lower the beta-to-alpha transus temperature, thus making these systems suitable for further study of the beta phase. A correlation was found between the beta-alpha upper solvus transition temperatures and electron-to-atom ratios for alloys of Be with Co, Cu, Fe, and Ni. Application of this relationship to ternary and quaternary alloys met with some success. On the basis of a few tests, the beta phase structure appears to be more ductile than the alpha phase structure at elevated temperature. A Be-8 at.% Ni alloy exhibited 20% reduction in area in tensile tests at 1070°C (at which temperature the alloy is mostly beta). Unalloyed Be exhibited zero reduction in area at this temperature. (auth)

2181 (NP-10933) EXO-REACTANT NICKEL BASE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 3, September 1, 1961–October 1, 1961. Ralph Armstrong (Narmco Research and Development. Div. of

Narmco Industries, Inc., San Diego, Calif.). Oct. 1961. Contract NOw-61-0308-c. 15p.

A method was developed for bonding stainless steel and nickel and cobalt base super alloys in air with a nickel alloy by utilizing an exothermic reaction, the products of which provide the braze alloy, flux, and the major part of the heat required. The work involved the further development of exotherm compositions and bonding techniques. The process was improved from the standpoint of reproducibility, and the quality of the bonds formed; also, a method involving a single technique and "exotherm" composition that is equally applicable to stainless steel, cobalt and nickel base super alloys was developed. Nickel alloy bonds of René 41 were tested in lap shear tensile, with six out of seven specimens tested failing in the base metal. (auth)

2182 (NP-10936) INVESTIGATION OF SINTERABLE POWDERS AND CERAMICS MADE FROM THEM. Third Quarterly Report. C. Hyde, A. Rudnick, M. J. Snyder, and W. H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). Oct. 20, 1961. Contract AF33(616)-7733. 14p.

Sintered MgO strength specimens prepared from calcined $MgCO_3$ exhibited cracks after treatment with fluorescent dye. A tumbling furnace was constructed for calcining with improved temperature and atmosphere control. Photoelastic studies of the diametral-compression test indicated that the stress distribution was independent of specimen length, if the load distribution was uniform. These studies also pointed out the importance of the type of padding material between the specimen and the loading platens. (D.L.C.)

2183 (NP-10939) HIGH-TEMPERATURE PROPERTIES AND ALLOYING BEHAVIOR OF THE REFRACTORY PLATINUM-GROUP METALS. Summary Report, April 1, 1958—August 31, 1961. R. W. Douglass, C. A. Krier, and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Aug. 31, 1961. Contract Nonr-2547(00). 185p.

A large number of studies on the high-temperature properties of the platinum metals is summarized. These studies included sintering and fabrication, annealing, spectral emissivities, compatibility with container materials, mechanical properties, alloying effects, and oxidation. The metals studied were iridium, osmium, palladium, platinum, rhodium, and ruthenium. (D.L.C.)

2184 (NP-10952) NON-METALLIC FIBROUS REINFORCED METAL COMPOSITIES. Status Report. E. S. Machlin (Materials Research Corp., Yonkers, N. Y.). Sept. 1961. Contract NOw 61-0209-c. 259p.

The literature on fibers and fiber reinforced composites has been reviewed and evaluated. It is concluded that, in principle, non-metallic fiber reinforced metals can have the largest strength/weight and modulus/weight ratios of all known materials, exceeding the values of those presently available by many factors, particularly at elevated temperatures. In practice, realization of the potential has been frustrated by two factors: thermal degradation of fiber strengths, and inadequate fabrication procedures. The inadequacies of fabrication techniques employed to date have been considered and the requirements for an adequate fabrication technique have been listed. (auth)

2185 (NP-10965) APPLICATIONS DE LA RADIOGRAPHIE X A L'EXAMEN DU GRAPHITE NUCLEAIRE. (Applications of X Radiography to Examination of Nuclear Graphite). P. Magnier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). June 1, 1960. 16p. (DPC/PCA/60-556)

A technique which determines some important elements in the structure of graphite, some dislocation lines, the presence of some dense impurities, and the local decreases in density, which develop in the course of oxidation, is described. (P.C.H.)

2186 (NP-10968) INFLUENCE DE LA STRUCTURE ET DE L'OXYDATION D'UN GRAPHITE SUR SA RESISTANCE A L'ECRASEMENT. COMPARISON AVEC SA PERMEABILITE SUIVANT SES AXES. (Influence of the Structure and Oxidation of Graphite on its Crushing Resistance. Comparison with its Permeability Along its Axes). P. Magnier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Mar. 30, 1960. 26p. (DPC/PCA/60-363).

The utilization of a method to study the permeability of graphite by means of small samples proved to be very interesting, because it permits the approach of some problems which the evolution of the technique renders at that time. The validity of the process was checked with a method of crushing, which is different as far as putting it into practice. Qualitative results established by permeability were obtained along with a quantitative parallelism between the evolution of the active region and the direction of the bursting curve as a function of the wear and tear of the graphite. It is felt that this ought to permit consideration of the values that are attached to these samples as actually representative of an existing physical state. It is also pointed out that the method of inward bursting ought to permit the measurement of the wear and tear state of graphites exposed to an atmosphere constituted by a mixture of CO_2 + CO, even if the reaction $2CO \rightarrow C + CO_2$ hinders the direct union of the wear and tear to the loss of weight of the graphite studied. (tr-auth)

2187 (NP-10973) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 1961. 50p.

Eighty-seven references on high strength alloys, light metals, monmetallics, and refractory metals are given to books and U. S. and foreign journals and reports from October 1960 to September 1961. Abstracts are included for each reference. (P.C.H.)

2188 (NP-10979) OXYDATION DE GRAPHITE TYPE G2—G3 IMPREGNE D'ALCOOL FURFURYLIQUE ET TRAITE A DIFFERENTES TEMPERATURES PAR LA HAWKER SIDDELEY NUCLEAR POWER COMPANY LIMITED. (Oxidation of Type G_2-G_3 Graphite Impregnated with Furfuryl Alcohol and Treated at Different Temperatures by the Hawker Siddeley Nuclear Power Company Limited.) Keraudy (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). May 16, 1960. 5p. (DPC/PCA/60-495)

Samples of type G_2-G_3 graphite were impregnated with furfuryl alcohol and then treated at different temperatures. The oxidation took place in air at 625°C (20 l/hr^{-1} flow). The impregnated products oxidized very rapidly at 1000°C. Some impregnated samples oxidized only slightly more at 1250 to 1600°C than nonimpregnated samples. All the samples, after thermic treatment in the vicinity of 3000°C, have some very similar oxidation rates, whether impregnated or not. (tr-auth)

2189 (NP-10981) BASIC FACTORS IN THE FORMATION AND STABILITY OF NON-SOAP LUBRICATING GREASES FOR USE AT ELEVATED TEMPERATURES. Quarterly Report No. 5. John J. Chessick, Albert C. Zettlemoyer, Carl Ruggles, and Edward Borger (Lehigh

Univ., Bethlehem, Penna. Inst. of Research). Oct. 1961. Contract AF33(616)-7120. 18p.

Monthly Report No. 17 is incorporated herein and will not be submitted separately.

A scientifically designed program was developed to study carbon blacks for use as high-temperature grease thickeners. This could be accomplished because of a diversity of properties such as their high melting point, surface polarity, surface area, particle size distribution, and dispersability, as well as promising characteristics shown in limited initial studies. Rather comprehensive studies revealed that Shell Roll Test stability at 650°F was excellent for greases containing carbon blacks with a high volatile content dispersed in Plexol 201. Stability decreased as volatile content decreased, a measure of polar oxygen complexes on the surfaces of these solids. This finding contradicted that of the previous studies. Syneresis, water stability, and stability to mechanical working at room temperature were not profoundly influenced by surface concentration of oxygen complexes. The results above were obtained with different carbon blacks. More fundamental studies revealed that ion-incorporation of at least a monomolecular layer of low melting inorganic compounds into the surface of high free surface energy solids, particularly silicas, does indeed occur. The treated solids are lowered in surface free energy, but not drastically in surface area, and possess profoundly improved properties for use as high temperature non-soap grease thickeners. Miscellaneous studies are discussed briefly. Most important of these is the use of an inorganic liquid in evaluating thickener solid properties. Initially, ion-incorporated silicas were tested as to stability in boiling bromine. A HiSil X303-Cr_2O_3 silica appeared unchanged by this treatment whereas profound changes in untreated HiSil were observed. More such studies using different inorganic liquids also are underway. While the liquids, chosen because of availability, are not suited for use as grease vehicles, these initial efforts are being undertaken to provide a foundation for understanding thickener-inorganic vehicle interactions as completely as that for solid-organic vehicle dispersions. (auth)

2190 (NP-10983) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 1, September 1, 1960—November 30, 1960. Harold H. Levine (Narmco Industries Inc., San Diego, Calif.). Dec. 1960. Contract NOw 61-0254-c. 61p.

The mechanism studies on the behavior of phenolics at elevated temperatures in the presence of air showed that a free radical mechanism was occurring. This resulted in the rupture of bonds, the formation of oxygenated materials, and stressed the general lability of the methylene bridge between the aromatic nuclei. Activation energy determinations indicated that chemisorption between metal fillers and resin is a distinct possibility. Tensile shear data on adhesive formulations failed to provide any significant trends. One trial resin combination withstood red heat on a spatula, in air, without burning or melting. Work on the synthesis of chelate polymers was started, using a low molecular weight nylon as a polymeric intermediate. (auth)

2191 (NP-10985) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Quarterly Progress Report No. 3, March 1, 1961 to June 1, 1961. Harold H. Levine (Narmco Research and Development. Div. of Narmco Industries, Inc., San Diego, Calif.). June 1961. Contract NOw-61-0254-c. 48p.

Constructive pyrolysis of laminates at 1800°F in an argon atmosphere resulted in a major improvement in oxidation resistance when exposed to circulating air at either 650 or 900°F. A silicone laminate, after this treatment, lost only 1.5% of its remaining resin content after 33 hours at 900°F. Despite the high pyrolysis temperature, the laminates retained a surprisingly large amount of their organic resin. Of further interest was the low resistivity after pyrolysis, ranging from 4 ohm-cm to 70 ohm-cm. The phenolic-181 E glass laminate had a room temperature flexural strength of just under 10,000 psi and a modulus of 5.4×10^6 psi. There was some indication that a chemical reaction occurs between E glass and the silicone resin. The X-278-A adhesive had a tensile shear strength of 847 psi after two minutes at 1000°F, with a rapid heat up cycle of only one minute to simulate a missile temperature profile. Mechanism studies on the sulfide curing compounds indicated that the type of epoxy polymerization is dependent upon the sulfur compound. Arsenic trisulfide appeared to undergo a sulfur-oxirane oxygen exchange, as does thiourea and dithiocarbamate salts. Lewis salts of 2-mercaptobenzothiazole and stannic chloride promoted a "regular" epoxy polymerization with the formation of hydroxyl groups. Synthetic efforts resulted in a polymer containing a –Si–O–Co– chain by reaction of cobalt acetate with a dialkoxysilane. A polyketone was prepared by oxidation of polybenzyl, which was made via polymerization of benzyl alcohol. Reaction of a nitrile rubber with hydroxylamine gave a polymeric amidoxine capable of reaction with nickel ions. Metal salts of 2-mercaptobenzothiazole were prepared and used to cure epoxy novolaks for mechanism studies and adhesive preparations. The desired p-phenylene diarsonic acid was synthesized from arsanilic acid; this will be used in polymerization reactions of epoxies and to synthesize polymeric arsenic compounds. (auth)

2192 (NP-10986) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Summary Report, August 1, 1959—September 29, 1961. Harold H. Levine (Narmco Industries Inc., San Diego, Calif.). Sept. 29, 1961. Contracts NOrd-19075 and NOw-61-0254-c. 28p.

Advances resulting from this work in adhesives and laminating resins, for potential use at 700 to 1000°F for periods up to an hour are discribed. Several adhesive systems are described which are of interest for exposures up to 10 minutes at 1000°F on 17-7 stainless steel. One side benefit of this research was an adhesive capable of good tensile shear strength for 250 hr at 500°F on steel and fair strength after 1000 hr at this temperature; one unusual characteristic is virtually no loss in strength from 500 to 1000 hr. As was the case with adhesives, the most heat stable laminating resins were either phenolic or silicone-phenolic (phenyl silane). Unlike the adhesives, the geometry of the reinforcement was important in determining the useful life of the composite. Definite potential was found for two commercial binder systems for high temperature resistant filament winding applications such as rocket motor cases. It was found that pyrolysis of laminates at 1800°F, in argon, resulted in significant increases in the oxidation resistance of laminates. In addition, such configurations became good semi-conductors. This process does not produce graphite because of the low temperature used, but results in what are believed to be polynuclear hydrocarbon polymers. Preliminary work was started to synthesize a completely new type of heat resistant binder system. This is called "Phenyl Glass," made by substituting a phenyl silicone resin for silica in the "E" glass formulation. Very high oxidation resistance was found in this material at 1000°F for 17 hr. This phase of the program started when evidence was found to indicate that a chemical reaction occurred between the silicone resin and the "E" glass fabric reinforcement. (auth)

2193 (NP-11023) A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTHS AND RELATED METALS. Semi-annual Progress Report No. 4, May 1, 1961 to October 31, 1961. Albert S. Yamamoto, Charles E. Lundin, and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). Nov. 1961. Contract AF-33(616)-6787. 23p.

The vapor pressures of praseodymium and neodymium were determined at 1724 to 1874°K and 1638 to 1791°K, respectively, by the Knudsen effusion method. The equations of vapor pressure as a function of temperature are: praseodymium: $\log_{10} p(\text{mm Hg}) = (-18,453 \pm 424)/(T) + 8.34 \pm 0.24$; and neodymium: $\log_{10} p(\text{mm Hg}) = (-18,373 \pm 482)/(T) + 9.57 \pm 0.28$. The heats of vaporization of praseodymium and neodymium, respectively, as calculated from the slopes of vapor-pressure plots, are $\Delta H_V = 84.42 \pm 1.94$ kcal/mole, and $\Delta H_V = 84.06 \pm 2.21$ kcal/mole. A tentative phase diagram for the binary system, praseodymium–neodymium, was established by room-temperature metallography and thermal analysis. Complete solid solubility in both the low-temperature and high-temperature phases occurs. The densities of a series of alloys were determined by the displacement method at room temperature. A plot of molal volume of solution as a function of mole fraction indicates that the solution approaches ideality. (auth)

2194 (NP-11060) INVESTIGATION OF DIFFUSION BARRIERS FOR REFRACTORY METALS. Progress Report No. 8, July 15, 1961–October 15, 1961. (Manufacturing Labs., Inc., Cambridge, Mass.). Oct. 30, 1961. Contract AF33(616)-6354. 36p.

Screening studies at 1700°C were continued with the evaluation of most of the remaining base-barrier combinations. These included W–Ru, W–Hf, W–Cr, W–V, Mo–Hf, Mo–V, Ta–Ru, Ta–Hf, Nb–Os, and Nb–Zr. Screening studies were extended to a temperature of 1800°C for promising W- and Ta-base combinations such as W–Os, Ta–W, Ta–Re, and Ta–Ir. Based on recent screening tests, the W–Hf combination was removed from the list of promising combinations and Mo–V, Ta–Ru, and Nb–Zr were added. The criteria for selection of optimum combinations were revised and now consist of the following: base-barrier interdiffusion, alloy melting point, barrier metal oxidation resistance, and barrier-coating interdiffusion. On the basis of these criteria, there are now 15 optimum combinations tentatively selected. (auth)

2195 (ORNL-TM-39) AN INVESTIGATION OF THE HIGH-TEMPERATURE PROPERTIES OF THE AISI TYPE 502 STEEL. W. R. Martin and H. E. McCoy, Jr. (Oak Ridge National Lab., Tenn.). Nov. 28, 1961. Contract W-7405-eng-26. 54p.

The mechanical properties of the AISI type 502 steel were investigated at both room and elevated temperatures. Properties such as bend, tensile, hardness, and environmental creep were evaluated as a function of various heat treatments. It was found that the room-temperature strength is increased as the solution annealing temperature is increased. The dependence of the mechanical properties at 1200°F on the heat treatment was not as significant as at room temperature although similar trends were observed. Creep tests in air, argon, and an Ar-5CO-5CO_2 mixture at 1200°F indicated an increase in the creep strength of this material in air and the Ar-5CO-5CO_2 environments as compared with that observed in argon. Room-temperature bend tests indicated that rupture ductility is seriously reduced if the carbon content exceeds 0.1 wt %. Compatibility tests on unstressed specimens in an Ar-5CO-5CO_2 mixture showed that the oxidation rate of the AISI type 502 steel is approximately linear with time at 1200°F. However, the oxide formed in the same mixture at 1500°F was more protective with a rate-time dependence of 0.73. As a result of these studies, it was concluded that the AISI type 502 steel is unsatisfactory for service at 1200°F in an environment composed primarily of helium with small partial pressures of CO and CO_2. (auth)

2196 (PWA-2012) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Progress Report, July 1, 1961 through September 30, 1961. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 50p.

Work was conducted in support of NASA space power systems. An aluminum phosphate coating completed 1600 endurance hours on a SNAP-8 finned-tube radiator segment in a long-term endurance rig. Plasmadyne "Titania Base" powder was used to coat both SNAP-8 and Sunflower I sections for testing in the second and third 10,000-hr endurance rigs. The total emittance was measured for the following coatings: aluminum phosphate with nickel-chrome spinel and silica filler on aluminum strip; plasma flame-sprayed titania on aluminum strip; plasma flame-sprayed calcium zirconate; aluminum phosphate with silicon carbide and silica filler on stainless steel tube; plasma flame-sprayed titania-alumina blend on aluminum strip; plasma flame-sprayed calcium titanate on stainless steel strip; and plasma flame-sprayed "Titania-Base" powder on stainless steel tube. Endurance testing was conducted on the first and last of these coatings. (auth)

2197 (R61SD051) THE AEROTHERMODYNAMIC BEHAVIOR OF PYROLYTIC GRAPHITE DURING SUSTAINED HYPERSONIC FLIGHT. E. J. Nolan and S. M. Scala (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Mar. 1961. 71p.

Presented at American Rocket Society Conference on Lifting Re-entry Vehicles, Palm Springs, California, April 6, 1961.

A detailed study is presented of the performance of pyrolytic graphite over the surface of a hypersonic lifting vehicle, including such critical locations as the leading edge and forward stagnation point. The surface oxidation rate and multidimensional temperature response were determined for various glide trajectories. Various values of the lift to drag ratio L/D were treated together with values of the wing loading parameter $W/C_L S$ between 25 and 500 lb/ft^2, and glide times up to several hours. Use was made of the orthotropic thermal properties of pyrolytic graphite to compute surface and substructure temperatures at various positions around the body. Surface oxidation and instantaneous surface heat transfer rates were computed self-consistently. Values of the maximum surface temperature and total oxidation were normalized for various values of the wing loading parameter $W/C_L S$, for both commercial and pyrolytic graphite. Using these results, many combinations of aerodynamic, geometric and structural factors can be evaluated systematically for multi-dimensional heat conduction. The analysis demonstrated the outstanding insulating qualities of pyrolytic graphite at high temperature. Upon introducing the latest experimental data on surface oxidation, it was also determined that pyrolytic graphite is probably the best oxidation-resistant high strength-to-weight ratio material presently available. It was therefore concluded that pyrolytic graphite is an excellent choice for the regions of intense heating on a hypersonic lifting re-entry vehicle, provided that structural requirements are also satisfied. (auth)

2198 (RADC-TR-60-236) METAL-TO-CERAMIC SEAL TECHNOLOGY STUDY. Final Technical Report, June 22, 1959 to September 22, 1960. S. S. Cole, Jr., W. L. Larisch, J. E. Inge, K. H. Styhr, Jr., and E. Cheatham (Sperry Gyroscope Co. Electronic Tube Div., Great Neck, N. Y.). Oct. 1960. Contract AF30 (602)2047. 116p. (AD-248535; NA-8240-8216)

To achieve ceramic-to-metal seals demonstrating strengths as high as the ceramic member itself required a testing program for their measurement and evaluation. A study was also conducted on the analytical and experimental nature of seal stresses. A literature survey was made. Two additional theories were formulated proposing the migration of the glass in the ceramic into the metallizing mixture and recognizing the need for promoting metallizing sintering. These theories, together with thermodynamic and equilibrium calculations, allowed 200 metallizing compositions to be formulated. Three sintering temperatures were chosen, depending on composition, for each of the 200 metallizing mixtures. Each mixture was applied to specimens of 94, 96, and 99.6% alumina. Approximately 3200 specimens were prepared and tested. The tensile test specimen was redesigned to eliminate shoulder breaks when evaluating ultra-high-strength seals. A photoelastic study was made to learn more about stress distribution in this specimen. Extremely strong seals were developed for all of the ceramic bodies considered. Analysis of the data indicated that simple chemical reactions are not enough to explain seal adherence. A study was made of the origin and nature of seal stresses resulting from the dissimilar physical properties of the metals and ceramics. A method to calculate stresses in ceramic-to-metal seals was theorized. Measurements of the properties of the metal and of residual stresses in seals were made, showing excellent agreement with calculated stresses. (auth)

2199 (TID-14140) LOW TEMPERATURE INTERNAL FRICTION IN PLASTICALLY DEFORMED MAGNESIUM. Preliminary Report. Report No. 6. Robert Tsang-Chu Tsui (Cornell Univ., Ithaca, N. Y. Materials Science Center). Sept. 1961. Contract AT(30-1)-2471. 88p.

The internal friction of hexagonal metal crystals of magnesium and zinc was studied at 4.2 to 300°K at frequencies of about 4 and 40 kc. Two kinds of internal friction peaks were found in cold worked polycrystalline and monocrystalline magnesium. The peak at 20°K behaved very much like the Bordoni type peak observed in f.c.c. metals. The broad peak or peaks occurring from 70 to 160°K showed a strong dependence on plastic deformation. Some measurements on deformed single crystals of zinc showed the existence of a broad internal friction peak in the vicinity of 210°K. Some preliminary experiments with single crystals of different orientations gave some indications of an effect of orientation. (auth)

2200 (TID-14181) CONDUCTIVITY OF THORIA POWDER IN CARBON DIOXIDE ATMOSPHERE. Technical Report No. 13. Ralph M. Horton, Melvin A. Cook, and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Oct. 25, 1961. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 1075. 28p.

Carbon dioxide was adsorbed on pellets pressed from thoria powder (22.8 m^2/g) and the conductivity isotherms determined at temperatures between 250 and 500°C in a d-c electric field. The conductivity isotherms are explained by two parallel resistances, one consisting of bulk conduction controlled by the particle-to-particle contacts and the other consisting of ionic conduction along the surface of the pores. A theoretical interpretation of the results is given. (auth)

2201 (TID-14185) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCALOY-2. First Quarterly Progress Report. (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Sept. 1961. Contract [AT(38-1)-252]. 30p.

Preliminary investigations made at 25°C indicated that twinning in a polycrystalline zirconium alloy containing a small amount of tin is highly dependent upon grain orientation. In tensile tests, varying in strain rate by a factor of 10^4, twins appeared to form primarily in grains with basal planes nearly normal to the stress axis. Slip, on the other hand, was apparently the predominant deformation mode in grains with basal planes nearly parallel to the stress axis. Slip and twinning in this polycrystalline material is therefore looked upon as cooperative deformation mechanisms rather than as competitive mechanisms. Assuming that the twinning modes are the same as those in pure zirconium, it was deduced that the most prevalent type of twin in the present tests should be $\{10\bar{1}2\}$. The deformation in a room temperature tensile test had a large time dependent component and appreciable rates of plastic flow by creep were observed under moderate loads. (auth)

2202 (TID-14231) STRESS ANNEALING IN THIN IRON FILMS; SOLID STATE PHYSICS PROGRAM. J. D. Finegan and R. W. Hoffman (Case Inst. of Tech., Cleveland). Aug. 1961. Contract AT(11-1)-623). 34p.

Measurements of macrostress in thin evaporated films of iron were carried out as the films were pulse annealed. Films 1100 A thick deposited on mica substrates held at 75, 125, and 175°C were annealed in 25°C temperature steps for a period of 15 minutes at each step. The maximum annealing temperature for most of the films was 500°C. The initial value of the stress was about 10^{10} $dynes/cm^2$. The graphs of stress as a function of annealing temperature showed a general decreasing trend which leveled off in the region of 400 to 500°C. The 175°C curves and, to a lesser extent, the 125 and 75°C curves showed a slight secondary peak in the region of 350 to 375°C. Incidental to the above work, four of the elastic constants in mica were measured. The results were $S_{11} = S_{22} = 6.5 \times 10^{-13}$ $cm^2/dynes$, $S_{12} = -1.5 \times 10^{-13}$ $cm^2/dyne$, and $S_{66} = 13. \times 10^{-13}$ $cm^2/dyne$. (auth)

2203 (TID-14257) SURFACE BOMBARDMENT STUDIES. Technical Progress Report Covering Period of February 15, 1961 to November 15, 1961. Report No. 2240. G. K. Wehner, G. S. Anderson, and C. E. KenKnight (General Mills, Inc., Minneapolis). Nov. 15, 1961. Contract AT(11-1)-722. 79p.

The continuation of atom ejection pattern studies for bcc metals and their extension to TiO and SiC crystals are described. A bcc is more open than an fcc structure and the results are therefore more diversified. Bcc metals are less noble than the fcc metals and their study consequently requires cleaner discharge conditions. This was accomplished by eliminating the thermionic cathode and creating the plasma by high frequency excitation. In bcc metals the <111> closely packed directions are the most pronounced ejection directions. At higher bombarding energy and especially with the lighter ions the next nearest neighbor <100> directions appear. On (110) surfaces the

<111> directions are split into two slightly different directions probably because atoms on top of a filled (110) surface are not in their normal lattice position but make bonds with 3 instead of 2 neighbors. Fe, W, and Nb patterns are very similar but Ta, V, and Mo patterns each differ in certain details which are not yet understood. Patterns from TiO and SiC are very poor but show that in TiO some focusing occurs in <110> directions and in SiC in <111> directions. Work in sputtering yield measurements with mass separated hydrogen beams is described. The hole drilling method described was used to determine Ni sputtering yields for 10 kev H_2^+ (0.045 atoms/ion) and H_3^+ (0.028 atoms/ion) ion bombardment. (auth)

2204 (WADC-TR-58-476(Vol.IV) (Rev.)) THERMOPHYSICAL PROPERTIES OF SOLID MATERIALS. VOLUME IV. CERMETS, INTERMETALLICS, POLYMERICS, AND COMPOSITES. Alexander Goldsmith, Thomas E. Waterman, and Harry J. Hirschhorn (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 1960. Contract AF 33(616)-5212. 798p.

Thermophysical property data, and their variation with temperature, are presented for a great number of solid materials, based on literature published during the period from 1940 to 1957. Each reported value is shown and annotated, and recommended "most probable value" curves are given. Materials covered include cermets, intermetallics, polymerics, and composite materials. Except for materials in the last two categories, only those melting above 1000°F are included. Properties covered include the following: melting point, density, latent heats, specific heat, thermal conductivity, thermal diffusivity, emissivity, reflectivity, thermal expansion, vapor pressure, and electric resistivity. (auth)

2205 (WADC-TR-58-476(Vol. V) (Rev.)) THERMOPHYSICAL PROPERTIES OF SOLID MATERIALS. VOLUME V—APPENDIX. Alexander Goldsmith, Harry J. Hirschhorn, and Thomas E. Waterman (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 30, 1960. Revised edition Nov. 1960. Contract AF33(616)-5212. 290p.

Thermophysical property data, and their variation with temperature, are presented for solid materials, based on literature published from 1940 through 1957. Materials covered include elements, alloys, ceramics, cermets, intermetallics, polymerics, and composite materials. Except for materials in the last two categories, only those melting above 1000°F are included. Properties covered include: melting point, density, latent heats, specific heat, thermal conductivity, thermal diffusivity, emissivity, reflectivity, thermal expansion, vapor pressure, and electric resistivity. Indexes and lists of references are included. (auth)

2206 (WADD-TN-61-18) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). Feb. 1961. Contract AF33(616)-6915. 98p.

A review is given of results so far of the development of graphite and carbon materials for missile and astronautics applications. Tests of various graphite grades as nozzle throat materials are reported. Data are given for numerous physical properties of various graphites: creep, thermal expansion, thermal conductivity, dislocations, electron spin resonance, and spectral properties. Studies on the deposition and the properties of pyrolytic carbon deposits are reported. The properties of fibrous graphite-base materials developed for high-temperature applications are given. Interpretations are presented of DTA graphs for the pyrolysis of some hydrocarbons. (D.L.C.)

2207 (WADD-TR-61-106) INVESTIGATION OF THE PROPERTIES OF TANTALUM AND ITS ALLOYS. Frank F. Schmidt, William D. Klopp, Daniel J. Maykuth, Horace R. Ogden, and Robert I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Feb. 20, 1961. Contract AF33(616)-5668. 154p.

The effects of alloying on the mechanical properties of tantalum have been studied. Both dispersion-strengthened and solid-solution strengthened tantalum alloys exhibit high-strength at elevated temperatures while maintaining good fabricability and excellent low-temperature ductility. Strength data to 1650°C are reported. The oxidation resistance of tantalum can be improved severalfold by alloying. Several alloying elements were found to be effective in reducing both scaling and contamination up to at least 1400°C. (auth)

2208 (AEC-tr-4865) THE VAPOR PRESSURE AND RATE OF EVAPORATION OF CERTAIN REFRACTORY COMPOUNDS IN VACUUM AT HIGH TEMPERATURE. A. S. Bolgar, T. S. Verkhoglyadova, and G. V. Samsonov. Translated by N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.) from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 1, 142-5(1961). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17344.

2209 (AEC-tr-4867) EQUILIBRIA IN THE Nb—C—O SYSTEM. F. G. Kusenko and P. V. Gel'd. Translated for Los Alamos Scientific Lab., N. Mex. from Izvest. Vysshikh Ucheb. Zavedenii, Tsvetnaya Met., No. 2, 43-52(1961). 11p.

The thermal reduction of Nb_2O_5 by C to NbO_2 can take place, from the thermodynamical standpoint, at P = 1 atm and T > 1230°K. The subsequent conversion of NbO_2 to NbO can be effected at P = 1 atm. and T > 1650°K. The conditions for the reduction of NbO to the metal are less favorable than for the processes leading to formation of the carbides. If the charge is designed for production of the metal, from the thermodynamical standpoint the first stage will be production of the highest carbide, which is reduced step-by-step to the lower carbide (or a solid solution) and the metal. The exponents of the last stage of the process largely govern the conditions for realization of thermal reduction by carbon. At P = 1 atm. this process becomes feasible above 2860°K, but it can be realized at 1550°C in a vacuum. Because of the formation of solid solutions of O_2 and C in Nb, higher temperatures and lower pressures are required. (auth)

2210 (AEC-tr-4871) ON THE CHARACTER OF THE REACTION OF CERTAIN REFRACTORY CARBIDES AND THEIR SOLID SOLUTIONS WITH CARBON. K. I. Portnoi, Yu. V. Levinskii, and V. I. Fadeeva. Translated by N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.) from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk. Met. i Toplivo, No. 2, 147-9(1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 25248.

2211 (DEG-Inf.-Ser.-176) SOME QUESTIONS ON THE STRENGTH OF SILICON CARBIDE BASED METALLOCERAMIC MATERIALS. V. T. Troshchenko. Translated by E. Bevitt (U.K.A.E.A., Risley, Lancs, Eng.) from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: No. 1, 103-7(1960). 7p.

The application of statistical theories of strength to the calculation of brittle metal-ceramic materials is discussed with relation to silicon carbide. It is shown that there is good agreement between formulas from Weibull's statistical theory of strength and experimental data obtained on the effect on strength, of size, type of stressed state, and concentration of stresses. (auth)

2212 (HW-TR-28) INFLUENCE OF HEAT TREATMENTS IN THE β AND γ PHASES ON THE MICROGRAPHIC STRUCTURE OF URANIUM. A. Robillard (France. Commissariat a l'Energie Atomique, Paris). Translated by Liz Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from report CEA-1057. 1959.

Thesis submitted to Univ. of Paris.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 7762.

2213 (JPRS-10499) PHYSICS CHANGES OF ELECTRIC RESISTANCE IN PRASEODYMIUM, DYSPROSIUM, ERBIUM, AND YTTERBIUM UNDER PRESSURE OF UP TO 250,000 kg/cm. L. F. Vereshchagin, A. A. Semerchan, and S. V. Popova. Translated from Doklady Akad. Nauk S.S.S.R., 139: 585-6(July 1961). 4p.

The electric resistance of praseodymium passes through a minimum at 110,000 kg/cm^2, increases with pressure to 150,000 kg/cm^2, and then decreases with increasing pressure. The resistance for dysprosium decreases with pressure to a minimum at 75,000 kg/cm^2, then increases with pressure by ~0.5%, and then decreases with pressure almost linearly. The electric resistance of erbium was found to decrease smoothly with pressure, and not to possess any peculiarities in the investigated range. The resistance of ytterbium increased with pressure to 50,000 kg/cm^2, decreases to 10% of the initial resistance on the addition of 10,000 kg/cm^2, and then does not change with increasing pressures. (B.O.G.)

2214 (NP-tr-754) ENTHALPY AND HEAT CAPACITY OF MOLYBDENUM IN THE 1200-2500°K TEMPERATURE RANGE. L. C. Lazareva, P. B. Kantor, and V. V. Kandyba. Translated from Fiz. Metal. i Metalloved., 11: 628-9(1961). 5p.

Enthalpy values were determined for molybdenum from 1164 to 2540°K, for which the enthalpy and temperature deviations were 0.3 to 1.1% and 0.1 to 0.5%, respectively, in the 1000 to 2500°K range. Heat capacity values are tabulated from 1100 to 2500°K. (B.O.G.)

2215 (NP-tr-779) MEASUREMENT OF THE PRESSURE DIFFERENCES OF $B^{10}F_3$ AND $B^{11}F_3$ VAPORS. A. V. Borisov and I. G. Gverdtsiteli. Translated from Zhur. Fiz. Khim., 35: 1212-14(1961). 5p.

The pressure of saturated vapors of isotopic mixtures of $B^{11}F_3$ and $B^{10}F_3$ concentrations of 81.6 and 18.6% was measured by the differential method in the temperature range of 160.0 to 170.4°K. In this temperature range $B^{11}F_3$ was the more volatile compound. Assuming the isotope solutions of $B^{10}F_3$ and $B^{11}F_3$ in the liquid and gas to be ideal, the enrichment factors were calculated from the experimental data. The enrichment factor increased with a drop in temperature from $(8.40 \pm 0.13) \times 10^{-3}$ at 170.4°K to $(10.10 \pm 0.24) \times 10^{-3}$ at 160.0°K. (auth)

2216 (NP-tr-801) TITANIUM AND ITS ALLOYS (TECHNICALLY PURE TITANIUM) (SELECTED PARTS). L. S. Moroz, B. B. Chechulin, I. V. Polin, L. V. Butalov, S. M. Shul'kin, and A. P. Goryachev. Translated from p.458-61; 477-92; Vol. 1, of "Titan i Ego Splavy, Tekhnicheski Chistyi Titan," Leningrad, 1960. 27p.

Welding and soldering of Ti and the best conditions for these operations are discussed, and data are given for the strength of the resulting joints. An oxygen-less flux was developed for welding Ti, and argon shielding was found to be necessary in addition to slag shielding. Soldering with both hard and soft solders is considered; Ag-base solders gave the best results for hard solders, while for soft solders, preliminary tinning was necessary. Finally, soldering of Ti to other metals is discussed. (D.L.C.)

2217 (NP-tr-809) INFLUENCE OF THE TIME FACTOR UPON THE COMPOSITION VERSUS HEAT RESISTANCE DIAGRAM OF ALLOYS OF THE FIVE-COMPONENT Ni–Cr–W–Ti–Al SYSTEM. I. I. Kornilov, L. I. Pryakhina, O. V. Ozhimkova. Translated from Issledovaniya po Zharoproch. Splavam, Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, 6: 278-83(1960). 10p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 11052.

2218 (UCRL-Trans-740(L)) ON THE MODIFICATIONS OF BORON. EXPERIMENTS ON THE INCORPORATION OF BERYLLIUM IN THE BORON LATTICE. H. J. Becher and A. Schaefer. Translated for Univ. of California Lawrence Radiation Lab., Livermore from Z. anorg. u. allgem. Chem., 306: 260-5(1960). 8p.

Experiments are described on the preparation of boron crystals which incorporate beryllium, by the mutual decomposition of BBr_3 and $BeBr_2$ on a heated tantalum filament. Together with inhomogeneous deposits which contained $TaBr_2$, on the surface of the wire, single crystals were isolated which contained 0.1 to 0.5% Be according to spectrographic studies, and possessed the crystal structure of tetragonal boron with unit cell dimensions $\underline{a}$ = 8.80A and $\underline{c}$ = 5.08A, based on rotating–crystal and Weissenberg–method photographs. (auth)

2219 DETERMINATION OF PHYSICAL PROPERTIES OF FLAME-SPRAYED CERAMIC COATINGS. Jerald L. Bliton and Harold L. Rechter (Illinois Inst. of Tech., Chicago). Am. Ceram. Soc. Bull., 40: 683-8(Nov. 1961).

The procedure of flame spraying the face of a 1-in. diameter cylinder, cementing a similar uncoated cylinder to the coated face, and then pulling the cylinder apart in a tensile testing machine was found to be an acceptable method of determining coating-to-substrate bond strength. The procedure of cementing a substrate-free coating between two cylinders permitted the determination of the tensile or cohesive strength of the coating itself. Increasing the substrate surface roughness did not significantly increase the coating-substrate adhesion, in fact a decrease was noted for the softer aluminum substrate. A 1 mil subcoat of a Ni-Cr alloy greatly promoted coating adhesion to all substrates investigated. Increasing the substrate temperature range during spraying from 200 to 400 to 200 to 800°F had no significant effect on Inconel, caused a marked increase in coating adhesion to Armco iron, and caused the coatings on aluminum to completely spall off upon cooling to room temperature. The method described for measuring air permeability of coatings was found to be easily performed and sensitive to coating technique. It was found that the air permeabilities of zirconia coatings decreased as the substrate temperature during spraying increased. The method used to determine the thermal conductivity of thin, 5- to 10-mil coatings was found feasible and was used to obtain a K value for zirconia of 4.1 Btu/hr-ft/°F/in. Coatings on Armco iron substrates were found to have higher emittance values than similar coatings on aluminum, and 4 mil coatings higher emittance values than 9 mil coatings. This was believed due to substrate show through. (auth)

2220 THERMAL CONDUCTIVITY OF SODIUM AND LITHIUM. I. I. Rudnev, V. S. Lyashenko, and M. D. Abramovich (Physico-Energetic Inst. of the State Committee for the Application of Atomic Energy). Atomnaya Energ., 11: 230-3(Sept. 1961). (In Russian)

A method was developed for determining the heat conductivity of liquid Na and Li in a wide temperature range, making use of a modified Angstrom method involving a pulsed heat source. The purified specimens were put into thin-walled steel tubes which were placed in an electric furnace kept in a vacuum chamber. Chromel-alumel thermocouples were used for the measurements. For the Na 24 measurements were made in the range from 350 to 880°C while for Li 54 points were obtained between 345 and 1007°C. From the data obtained and from known values of the density and the heat capacity of these metals the thermal conductivity of the metals were calculated as follows: $\lambda_{Na} = 0.224 - 0.0159 \cdot 10^{-2}\ T + 0.00058 \cdot 10^{-4}\ T^2$; $\lambda_{Li} = 0.072 + 0.01271 \cdot 10^{-2}\ T - 0.00039 \cdot 10^{-4}\ T^2$ cal/cm/sec/degree C. (TTT)

2221 X-RAY ANALYSIS OF THE RHENIUM—THORIUM SYSTEM. J. Niemiec (Inst. of Physical Chemistry, Wrocław Branch, Polish Academy of Sciences and Technical Univ., Wrocław, Poland). Bull. acad. polon. sci., Ser. sci., chim., 9: 501-6(1961). (In English)

Rhenium—thorium alloys were prepared by sintering or arc melting suitable powder quantities of rhenium metal, thoroughly reduced with hydrogen at 1200°, and thorium metal, containing 0.5% O_2. No differences of lattice constants in the limits of experimental errors were observed between samples annealed at 1350, 800, and 400°C. No mutual solubility of rhenium in thorium or of thorium in rhenium was detected. One intermetallic compound corresponding to Re_2Th was identified. The proposed structure of Re_2Th was established as a Laves phase of the $MgZn_2$—Cl_4 type. Assuming interatomic distances in pure metallic thorium d_A = 3.597 Å and in rhenium d_B = 2.740 Å, the ratio W for Re_2Th is 1.313. The data are tabulated. (P.C.H.)

2222 STUDY OF THE SELF-DIFFUSION OF URANIUM IN THE α PHASE. Yves Adda, Alexis Kirianenko, and Claude Mairy. Compt. rend., 253: 445-7(July 17, 1961). (In French)

The self-diffusion coefficients and the activation energy corresponding to self-diffusion in α-phase U were determined. An autoradiographic study shows that volume self-diffusion is accompanied by intergranular self-diffusion under 600°C and that the diffusion anisotropy is probably weak. (tr-auth)

2223 EFFECT OF ADDITIONS OF MOLYBDENUM, ZIRCONIUM, AND NIOBIUM ON THE SELF-DIFFUSION OF URANIUM IN THE γ PHASE. Yves Adda, Alexis Kirianenko, and Michel Bendazzoli. Compt. rend., 253: 653-5(July 24, 1961). (In French)

The self-diffusion of uranium was studied in alloys containing 10 at.% molybdenum, zirconium, or niobium. The diffusion coefficients, activation energies, and the frequency factors corresponding to the self-diffusion in these different alloys were determined. The results obtained seem to indicate that the diffusion mechanism is probably little different from that corresponding to the self-diffusion in pure uranium. (tr-auth)

2224 THE EXISTENCE OF A CONTINUOUS TRANSITION BETWEEN THE FLUORINE STRUCTURE AND THE TYPE Tl_2O_3 STRUCTURE IN THE ZIRCONIUM OXIDE—RARE EARTH OXIDE SYSTEMS. Monique Perez y Jorba, Francine Queyroux, and Robert Collongues. Compt. rend., 253: 670-2(July 24, 1961). (In French)

The evolution of the structure of a cubic solid solution was followed as a function of the concentration in rare earth oxides. The systems studied were $ZrO_2-Gd_2O_3$, $ZrO_2-Dy_2O_3$, and $ZrO_2-Yb_2O_3$. It is shown that at high temperature a continuous transition between the structure of the fluorine type and the structure of the Tl_2O_3 type occurs when the concentration of rare earth oxides is increased. (J.S.R.)

2225 MEASURING THE VAPOR PRESSURE OF THALLIUM BY A RADIOACTIVE TRACER METHOD. L. Kh. Genov, An. N. Nesmeyanov, and Yu. A. Priselkov (Moscow State Univ. and Chemical-Technical Inst., Sofia). Doklady Akad. Nauk S.S.S.R., 140: 159-61(Sept. 1, 1961). (In Russian)

Pure thallium metal containing Tl^{204} as a tracer (2 mc/g) was placed in a BeO crucible which was put inside a molybdenum furnace. The temperature was measured with chrom-alumel thermocouples. The vapor pressure of the thallium was calculated from the formula: lg P = 17.14 G (T/M), where P is the vapor pressure in mm Hg, T is the temperature in °K and G is the rate of diffusion of the metallic thallium through an opening in the top of the BeO crucible. G was calculated from the formula: $G = g/\tau K\sigma$, where g, the amount of evaporated material, was determined by counting the Tl^{204} vaporized, τ is the time, and K is the Clausing coefficient. The data obtained by diffusing thallium through various openings show that lg P = 8.0871 – 8899.4/T. Since Tl_2O is more volatile than Tl, precautions were taken to remove oxides by heating the metal in vacuum for a prolonged period of time. The average heat of vaporization of Tl metal was found to be $\Delta H_T = 40.72$ kcal/mol in the temperature interval of 519 to 924°K. The average value of ΔH_0^0 was calculated to be 43.12 ± 0.27 kcal=mol. (TTT)

2226 THE FINE STRUCTURE OF THE X-RAY K-ABSORPTION SPECTRA OF TITANIUM IN TiC—TiN SOLID SOLUTIONS. E. E. Vainshtein and E. A. Zhurakovskii (Inst. of Inorganic Chemistry of the Siberian Div., Academy of Sciences, USSR and Inst. of Metal-Ceramics and Special Alloys, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 560-2(Sept. 21, 1961). (In Russian)

Mixtures of TiC and TiN containing 25, 33, 50, 67, and 75% of one component were subjected to x-ray analysis and showed the presence of only a single phase of the NaCl type. The K-absorption edge of Ti in the TiC—TiN was taken photographically. The optimum density of the absorber was found to be 4.5 to 5.0 mg/cm² for all the alloys. The average K-absorption edges of Ti in the alloys obeyed the relationship: $\mu(\lambda) = \mu_1(\lambda)\chi + \mu_2(\lambda)(100-\chi)$ where μ_1 and μ_2 are the absorption coefficients of Ti in TiC and TiN, respectively and χ is the percent content of one component in the solid solution. The data indicate that there is a gradual replacement of one metalloid by the other in the solid solution. The 3d-electrons of Ti do not interact appreciably with the valence electrons of the metalloids. The properties of the alloys are primarily determined by the behavior of the 4s-electrons of Ti and the valence electrodes of the corresponding metalloids. (TTT)

2227 THE PRINCIPLE OF EQUIVALENT EFFECTS OF TEMPERATURE AND RATE ON Ni AND Ni—Cr ALLOY (18.3 At. % Cr) RESISTANCE TO DEFORMATION. V. F. Sukhovarov (Kuibyshev Tomsk State Univ.). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 3, 147-54(1961). (In Russian)

At precrystallization temperature the temperature-deformation rate ratio of Ni is dependent upon the activation energy changing regularly with the degree of deformation. The activation energy of Ni—Cr alloy does not depend on the degree of deformation. Postulations were made on the nature of the processes that determines the temperature-deformation rate ratio of Ni and Ni-Cr alloy. (tr-auth)

2228 ELASTIC-PLASTIC TRANSITION IN COPPER CRYSTALS AS DETERMINED BY AN ETCH-PIT TECHNIQUE. F. W. Young, Jr. (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 32: 1815-20(Oct. 1961).

Copper (99.999%) crystals with a dislocation density of 50/mm^2 were prepared. These crystals were stressed by applying a pure bending moment, and they were etched with a dislocation etch either before and after or while the stress was applied. The motion of dislocations was determined by observing the size and nature of the dislocation etch pits. The resolved stress necessary to move grown-in dislocations was about 4 g/mm^2. Examples of dislocation motion under stress, then return motion when the stress was removed, and of multiple motion under stress were observed. Multiplication of dislocations occurred at a resolved stress of about 18 g/mm^2. The observed phenomena are discussed in terms of simple dislocation theory. (auth)

2229 EFFECT OF HYDROSTATIC PRESSURE ON THE HIGH-TEMPERATURE STEADY-STATE CREEP OF LEAD. B. M. Butcher and A. L. Ruoff (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 32: 2036-8(Oct. 1961).

The activation energy and activation volume for the creep of high-purity lead were obtained by the method of rapidly varying the temperature and pressure. The activation energy was found to be 1.18 ± 0.03 ev and the activation volume was found to be $(24.? \pm 0.6) \times 10^{-24}$ cc or 0.80 atomic volume. (auth)

2230 THE STUDY OF LATTICE DEFECT IN GRAPHITE BY THE EMANATION OF FISSION PRODUCT RARE GAS. Sumio Ichiba (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 763-6(Oct. 1961). (In Japanese)

Lattice effects in graphite were studied by the use of emanating fission product xenon which had been trapped by fission recoil. Four peaks were found in the heating curve of natural graphite but not in artificial graphite. The activation energies for xenon release were measured at temperatures where these peaks appear. The observed activation energies at each peak were compared with the calculated values and the classification of lattice defects was considered. The lattice defects in natural graphite were caused by fission recoil and they were elucidated as the interstitial cluster, single vacancy, combination of single vacancies, and di-vacancy, respectively. (auth)

2231 SOME STUDIES ON METALLURGICAL BEHAVIOR OF MAGNOX ALLOY. II. PHENOMENA OF CAVITATION AND CRACKING DURING CREEP. Ryukichi Nagasaki and Kensuke Shiraishi (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 779-86 (Oct. 1961). (In Japanese)

Creep tests were carried out on Magnox, Mg-1% Al, and Mg-1% Zr alloys at several temperatures in the range from 300 to 500°C under several stresses in the range from 0.15 to 0.38 kg/mm^2. After the creep test, specimens were cut out to investigate the phenomenon of cavitation in these alloys during creep test. Average creep rates of Magnox alloys under these conditions are the order of $10^{-3} \sim 10^{-1}$%/hr. Magnox A12, possesses higher creep strength than other Magnox alloys. Creep specimens show ductile fracture at the temperature of 400°C or above and brittle fracture at the temperature of 300°C or below. The surface of the specimen becomes rough by creep deformation. Cavities are formed preferentially in grain boundaries normal to the stress axis at early stage of secondary creep mainly caused by grain boundary sliding. In the case of higher stress, cavities and cracks are mainly created at triple points of grain boundaries. At constant temperature, for a given amount of strain, the number of cavities increases with decreasing strain rate, and for a given strain rate it increases with total amount of strain. Cavities are formed easily at the temperature range from 300 to 400°C, and they are not formed at the temperature of 500°C and above. (auth)

2232 IMPEDANCE PHENOMENA IN MOLTEN SALTS. G. J. Hills and K. E. Johnson (Imperial Coll. of Science and Tech., London). J. Electrochem. Soc., 108: 1013-18(Nov. 1961).

Impedances were measured of polarized platinum microelectrodes in the molten salt systems, LiCl-KCl at 400°C, $NaNO_3$-KNO_3 at 270°C, NaBr-$AlBr_3$ at 225°C, and $PbCl_2$ at 530°C. Frequency dispersion of both the observed resistance and capacitance was evident in all cases, but apparent double layer capacities obtained by extrapolation to infinite frequency were in reasonable accord with some previously reported data. They were of magnitudes consistent with a simple Helmholtz model although the anodic values tend to be high, perhaps because of specific adsorption. Some measurements of faradaic impedance were also made, but these were less successful and the exchange current for the Pt/Pt^{2+} system was high. (auth)

2233 ELECTRICAL CHARACTERISTICS OF ANODIZED NIOBIUM FOIL AND SINTERED PELLETS. Robert B. Hand, Harry W. Ling, and Thaddeus L. Kolski (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Electrochem, Soc., 108: 1023-8(Nov. 1961).

Anodized niobium foil and sintered pellets were evaluated in terms of capacitance, leakage, and dissipation factor. Calculated film thickness was shown to be proportional to forming voltage. Field strength in the oxide after anodization was an exponential function of reciprocal absolute temperature for films formed at 25 ma/in.^{2}, but not at 2.5 ma/in.^{2}. An average charge value of 82 μf v/in.^{2} was found for foils anodized over a forming potential range of 50 to 250 v, and between temperatures of 25 and 100°C. Sintering pellets at 2100°C and using 0.01% H_3PO_4 electrolyte permits anodization to 200 v. Several solid electrolyte capacitors were prepared which had low leakage levels at 35 working volts. (auth)

2234 MATERIALS PROBLEMS IN CESIUM THERMIONIC CONVERTERS. Ling Yang and F. D. Carpenter (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Electrochem. Soc., 108: 1079-86(Nov. 1961).

The performance of various materials and the requirements that they must meet for use as a hot cathode, a cold anode, and a ceramic insulator are discussed. The unique features associated with a cesium thermionic converter, which are the causes of serious material problems, are high temperature, partial vacuum, presence of cesium vapor, close spacing between the electrodes, and presence of intense radiation and fission products (only for the conversion of fission heat). The materials used should deliver useful and dependable performance for long periods of time (several watts per square centimeter or more output and 25% or better efficiency of conversion for one year or more). (N.W.R.)

2235 FURTHER EVALUATION OF BERYLLIDES. J. R. Lewis (Atomics International, Canoga Park, Calif.). J. Metals, 13: 829-32(Nov. 1961).

An investigation was made of the microhardness, elastic modulus, and thermal stability of $NbBe_{12}$ and $ZrBe_{13}$ as a function of temperature below 1000°C. The following results were found: brittle behavior of MBe_{12} and MBe_{13} beryllides is to be expected in view of their limited mechanism for plastic slip; a reduction in impurity level could reduce, but probably never eliminate, the low ductility of beryllides; there is evidence for an abrupt change in elastic modulus for $ZrBe_{13}$ and $NbBe_{12}$ at or around 600°C; abrupt changes in hardness occur in both $NbBe_{12}$ and $ZrBe_{13}$ at about 150°C and again in the range 600 to 800°C; catastrophic failure may occur in $ZrBe_{13}$ if heated at 700°C in air; and catastrophic oxidation may occur in $NbBe_{12}$ if heated at 900°C in air. A course for future action on beryllide programs is also suggested. (P.C.H.)

2236 RECRYSTALLIZATION OF DEFORMED ALPHA-URANIUM SINGLE CRYSTALS. Lowell T. Lloyd (Argonne National Lab., Ill.). J. Nuclear Materials, 2: 141-6(June 1960).

The orientation relationship between deformed and recrystallized alpha-uranium can be expressed at 27.5° rotations about axes located 70.0° from the [100], 63.5° from the [010], and 34.0° from the [001]. In deriving this relationship it was necessary to consider the recrystallized grains found upon annealing deformed single crystals as originating from twins as well as from the parent crystal. Comparisons of deformation and recrystallization textures of polycrystalline uranium agree well with the finding. (auth)

2237 GENERAL AND NUCLEAR-PHYSICAL ASPECTS CONCERNING THE APPLICATION OF ALUMINIUM IN THE CONSTRUCTION OF REACTORS. P. Eversheim. Kerntechnik, 3: 454-8(Oct. 1961). (In German)

Special circumstances in the operation of reactors have caused a number of materials to become particularly interesting for research. These materials must fulfill very specific prerequisites. Furthermore, the multitude of reactor types call for a precise adaptation of the construction elements to the occurring temperatures which determine the efficiency of the reactor to a large extent. In addition to the structural requirements, the characteristic properties in reference to the neutron absorption must be mentioned above all. The discussion presents a survey on the properties of aluminum and the most important aluminum alloys. (auth)

2238 THE MEASUREMENT OF THE SURFACE AREA OF URANIUM DIOXIDE POWDER. Pietro R. Gorla (Dept. of Mines and Technical Surveys, Ottawa). Nuclear Sci. and Eng., 11: 48-54(Sept. 1961).

A comparative method was developed for determination of surface areas of UO_2 powder. The method depends on the sorption of phosphate ions from a solution containing P-32 labeled NaH_2PO_4 on the powder surface. By comparison with samples of known surface area, measurements were obtained in the range 1.0–14 meter^2/gm. The internal consistency of the method is better than ±2% and agreement with measurements by the BET (Brunauer-Emmett-Teller) method averages around ±5%. The method is simple and fairly rapid, and can be adapted to irradiated material. (auth)

2239 OBSERVATIONS ON URANIUM OXIDE SINGLE CRYSTALS. L. L. Colombo, J. C. Danko, and H. M. Ferrari (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 11: 98-9(Sept. 1961).

X-ray and metallographic analyses revealed that many of the particles, obtained in the form of swageable grade powder, are single crystals or aggregates of very few single crystals. A tendency to cleave, especially after deep etching in nitric acid, was found. Back-reflection Laue patterns were revealed, and the Tukou hardness value averaged 538. The degree of perfection for one of the crystals proved to be high. (L.N.N.)

2240 A THEORY OF THE ELECTRICAL PROPERTIES OF LIQUID METALS. I. THE MONOVALENT METALS. J. M. Ziman (Univ. of Cambridge, Eng.). Phil. Mag. (8), 6: 1013-34(Aug. 1961).

The mean free path of an electron in a liquid metal depends on scattering by the ions. The cross section of each ion depend on its "pseudo-potential," estimated from the band gap in the solid. If the ions are scattered independently, the mean free path is too short. But there is strong correlation between the positions of the ions in the liquid, giving rise to coherence between waves diffracted by adjacent ions. Using simple perturbation theory, it is shown that the resistance should depend on the Fourier transform, a(K), of the radial distribution function, and should be smaller than for independent scatterers. The density fluctuations of the liquid also scatter electrons, through imperfect screening by the "other electrons" of the coulomb fields of the ions. This "plasma resistance" is the main effect in liquid Na, where the band gap is small. When this term is subtracted, the resistivities of the other monovalent metals come out according to the theory, being approximately proportional to the squares of their pseudo-potentials. The change of resistance on melting is shown to be due to the change in the radial distribution function. Different ratios of ρ_L/ρ_s are explained through differences in the scattering cross sections of ions of different metals—especially the differences in the ion core "pseudo-potentials." The temperature variation of the resistivity follows from the temperature dependence of a(K). The thermoelectric power in the solid, and in the liquid, and its change on melting, all follow qualitatively from the form of a(K) and of the scattering cross section for each type of ion. (auth)

2241 THE DIRECT OBSERVATION OF LATTICE DEFECTS BY FIELD ION MICROSCOPY. D. G. Brandon and M. Wald (Univ. of Cambridge, Eng.). Phil. Mag. (8), 6: 1035-44(Aug. 1961).

Observations of Mo and W in the field ion microscope reveal the structure of edge dislocations and a grain boundary in molybdenum. Tungsten is irradiated with 5 mev α-particles and the production of vacancies at the surface observed. It is shown that this technique can be used to investigate the atomic structure at a grain boundary and around the core of a dislocation while it is applied to the study of radiation damage to give information about the distribution and range of the damage produced by a single high-energy impact. (auth)

2242 THE STRUCTURE OF GRAPHITE. T. Anno and C. A. Coulson (Oxford Univ.). Proc. Roy. Soc. (London), A264: 165-75(Nov. 7, 1961).

An investigation is made of the stability of a graphite layer, several possible types of deformation being considered. In the first (type I) mode of deformation the lengths of all three bonds starting from any atom in the layer are different, while the translational symmetry of the hexagonal configuration within a layer is still maintained. In the second (type II), alternate hexagons remain regular, but the lengths of the bonds joining them differ from the lengths of the bonds in a hexagon. It is found that there are two types within this category, distinguished as IIA and IIB. No account is taken of the interaction between layers. The calculation is based on the Hückel version of the molecular-orbital method for the π-electrons, with inclusion of an energy term representing the compression of the σ-bonds.

It is shown that for all three types of deformation, with reasonable numerical values for the parameters, the regular configuration usually adopted does indeed correspond to an absolute minimum of the total energy with respect to these modes of deformation. (auth)

2243 TWINNING IN GRAPHITE. E. J. Freise and A. Kelly (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A264: 269-76(Nov. 7, 1961).

A detailed investigation was made of twins in graphite crystals. The twins are regions misoriented from the crystal by a rotation of 20° 48′ about a direction in the basal plane. The twin boundaries are shown to be simple tilt boundaries of a particular angle. As well as twins, bend planes of varying angle are also observed in graphite crystals. The dislocation structure of the twin boundary is deduced and the effect of twins on the mechanical properties of graphite crystals is considered. (auth)

2244 URANIUM OXIDE—FUEL OF THE FUTURE. B. T. Bradbury (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Research (London), 14: 423-9 (Nov. 1961).

The use of metallic uranium fuel in a nuclear reactor imposes a limit on the temperature of operation and hence on the over-all efficiency of the reactor. Uranium oxide is one of the ceramics which may replace uranium metal as a reactor fuel. The properties, irradiation behavior, and potentialities of this material as a reactor fuel are discussed. (auth)

2245 TRANSACTIONS OF AMERICAN SOCIETY FOR METALS. VOLUME LIII. 1961. T. C. DuMond, ed. Trans. Am. Soc. Metals, 53: 1-1111(1961).

A large number of papers on metals and related topics are presented. Separate abstracts were prepared for thirteen of these papers, which dealt with phase diagrams and properties of alloys and systems. (D.L.C.)

2246 EFFECT OF LOW ALLOY ADDITIONS ON THE PROPERTIES OF URANIUM. W. H. Friske, H. E. Kline, and M. H. Binstock (Atomics International, Canoga Park, Calif.). Trans. Am. Soc. Metals, 53: 29-41(1961).

The mechanical and metallurgical properties of six low alloy uranium alloys were investigated. The alloy addition of 3.5 wt. % molybdenum to uranium increased stability during thermal cycling, creep strength, and tensile strength at 900°F. The addition of 0.5% silicon to the U—3.5 Mo binary alloy increased the creep strength at 900°F. The addition of 0.1% Al to the U—3.5 Mo binary alloy further increased both creep and tensile properties at 900°F. A U—2 Zr—0.1 Al alloy exhibited poor dimensional and geometric stability during thermal cycling. (auth)

2247 THE TERNARY SYSTEM CADMIUM—BISMUTH—INDIUM. E. A. Peretti (Univ. of Notre Dame, Ind.). Trans. Am. Soc. Metals, 53: 95-107(1961).

The cadmium—bismuth—indium ternary system was investigated by thermal analysis, microscopic, and x-ray methods. Cadmium dominates the diagram occupying 75% of the compositional area of primary crystallization. In four other regions, bismuth, alpha (indium-rich phase), beta (In_2Bi), and gamma (InBi), respectively, are the primary phases. A reaction occurs in the bismuth-rich portion, and two ternary eutectics occur in the system. One, consisting of cadmium, gamma, and beta, melts at 77.5°C; and the other, containing cadmium, beta, and alpha, melts at 61.5°C. The former is at 10% Cd, 48.5% Bi, and 41.5% In; the latter has a composition of 7.5% Cd, 30.83% Bi, and 61.77% In. (auth)

2248 THE SYSTEMS Y—Fe, Y—Ni, AND Y—Cu. R. F. Domagala, J. J. Rausch, and D. W. Levinson (Illinois Inst. of Tech., Chicago). Trans. Am. Soc. Metals, 53: 137-55(1961).

Phase relationships in the binary systems Y—Fe, Y—Ni, and Y—Cu were determined. Arc-melted alloys were heat treated at appropriate temperature intervals, water quenched, and studied metallographically. The results of such studies, coupled with complementary x-ray and melting point work, permitted the construction of the three binary diagrams. (auth)

2249 ON THE HARDENABILITY EFFECT OF BORON IN STEEL. R. A. Grange and J. B. Mitchell (U. S. Steel Corp., Monroeville, Penna.). Trans. Am. Soc. Metals, 53: 157-85(1961).

Factors which determine the quantity precipitated and rate of precipitation of the boron constituent were investigated in a series of Type 86B00 steels containing 0.2, 0.5, and 0.8% C. Precipitation of boron constituent prior to or during the early stages of transformation entails a loss in the effectiveness of boron. The loss in hardenability when boron steels are austenitized at too high a temperature is shown to be directly related to the kinetics of precipitation of boron constituent. The marked decrease in the hardenability effect of boron as carbon content of steel increases is attributed to the observation that, for any given amount of boron dissolved in austenite, boron constituent precipitates faster and in greater quantity the greater the carbon content of the steel. Boron has a potent hardenability effect in minute percentages, possibly because it concentrates at preferred nucleation sites as austenite is cooled to the transformation temperature range. (auth)

2250 THE CONSTITUTION OF RHENIUM—COLUMBIUM ALLOYS. P. Levesque, W. R. Bekebrede, and H. A. Brown (Raytheon Mfg. Co., Waltham, Mass.). Trans. Am. Soc. Metals, 53: 215-26(1961).

The rhenium—niobium system was investigated and a constitutional diagram has been proposed. Alloys were arc-melted, heat-treated, and examined by metallographic and x-ray techniques. Melting point determinations and a limited amount of hardness data were obtained. Niobium dissolves 40% rhenium at 1200°C and 42.5% at 2350°C, with a linear decrease in lattice spacing. A two-phase field containing the beta solid solution and intermediate chi phase was found extending from 42.5 to 64% at 2200°C. The chi phase is isomorphous with alpha manganese. The eutectic composition at the eutectic temperature of 2380°C is 47.5% rhenium. The single-phase chi extends from 64 to 87% at 2200°C and undergoes a peritectic decomposition at 2720°C. At low temperatures, a peritectoid reaction is responsible for the appearance of a phase corresponding to ReCb. Its decomposition temperature is 1075°C. The solubility of niobium in rhenium is about 4% at 2720°C and less than 2% at 2100°C. In rhenium—niobium alloys, the chi phase is a stable phase at high temperatures, while in the rhenium—tungsten and rhenium—molybdenum systems chi is stable at low temperatures. (auth)

2251 LIQUID-METAL FUEL CONSTITUTION. II. LIQUIDUS CURVES OF THE URANIUM—ZIRCONIUM—BISMUTH SYSTEM. Donald G. Schweitzer and John R. Weeks (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Soc. Metals, 53: 259-64(1961). (BNL-4364)

The liquidus curves of the uranium—zirconium—bismuth ternary system at 350, 375, 400, and 425°C were determined. The data indicate the existence of a series of ternary intermetallic compounds or a solid ternary phase with a wide range of U:Zr ratios in equilibrium with the liquid. The addition of 1 wt. % Mg to the liquid increases the solubility of the ternary phase. (auth)

2252 THE STRUCTURE AND MECHANICAL PROPERTIES OF URANIUM–TITANIUM MARTENSITES. D. L. Douglass (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Am. Soc. Metals, 53: 307-19(1961).

Small amounts of titanium were very effective in increasing the strength of martensitic uranium. The strengthening effect saturated at about 2 at. % Ti and was not due to the presence of a second phase. Lattice parameter changes with composition were continuous: both a_0 and c_0 increased with increasing solute, whereas b_0 decreased. The measured changes were greater than those calculated on the basis of size differences alone. Severe broadening of the x-ray-diffraction lines indicated the presence of nonuniform microstresses. The volume strain which occurred during the transformation of $\gamma \rightarrow \alpha'$ at the M_s temperature decreased at approximately 2 at. % Ti. It is suggested that the hydrostatic pressure caused during transformation decreased at this composition and was less than the yield point in alloys containing more than 2 at. % Ti. Tangential stresses existed at the surface as the outer portion of each sample transformed prior to the interior. Both stresses were sufficient to cause plastic deformation as evidenced by twins in the martensite and sample distortion. (auth)

2253 LAVES-TYPE PHASES OF HAFNIUM. Rodney P. Elliott (Illinois Inst. of Tech., Chicago). Trans. Am. Soc. Metals, 53: 321-9(1961).

The Laves-type intermetallic compounds HfV_2, $HfCr_2$, $HfMn_2$, $HfFe_2$, $HfCo_2$, $HfMo_2$, and HfW_2, prepared from high-purity iodide-grade hafnium, were investigated by powder diffraction techniques, HfV_2, $HfCo_2$, $HfMo_2$, and HfW_2 are isomorphous with the $MgCu_2$ type of structure; $HfMn_2$, the $MgZn_2$ type of structure; and $HfFe_2$, the $MgNi_2$ type of structure. $HfCr_2$ is of the $MgZn_2$ type of structure except at 1200°C, where the $MgCu_2$ type of structure prevails. Line intensity measurements corroborated these findings. (auth)

2254 OXIDATION OF ZIRCONIUM–COLUMBIUM ALLOYS IN OXYGEN AT 525 TO 1090°C. Otto Zmeskal and Mary L. Brey (Univ. of Florida, Gainesville). Trans. Am. Soc. Metals, 53: 415-31(1961).

Alloys of high-purity zirconium and niobium were heated in oxygen at pressures lower than atmospheric and temperatures ranging from 525 to 1090°C. Rates of oxidation at constant pressure and temperature were measured by a volumetric procedure for periods of 2 to 6 hr. X-ray-diffraction patterns were made of the free oxides. At 600°C, the oxidations conformed approximately to the parabolic rate law during the early stages of oxidation; at 900°C the general relationship, w^n-kt, was not followed by any of the alloys in the oxidation process, but all appeared to increase gradually in rate toward a linear relationship. At 1090°C values of n ranging from about 3 for alloys low in niobium to 2 for alloys high in niobium remained approximately constant during the period of measurement. (auth)

2255 CONSTITUTION OF THE PARTIAL SYSTEM: URANIUM MONOCARBIDE–URANIUM DICARBIDE. W. Chubb and W. M. Phillips (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Soc. Metals, 53: 465-78 (1961).

It is demonstrated that a miscibility gap exists between UC, having the NaCl-type crystal structure, and the high-temperature allotrope of UC_2, having the CaF_2-type structure. Evidence for immiscibility of these structures at 2200°C is presented. The additional reactions demanded by such a miscibility gap are described. A eutectic was located at 6.4 wt. % carbon and 2350°C between UC containing about 6.0 wt. % carbon and UC_2 containing about 6.6 wt. % carbon. A eutectoid was located at 7 to 7.5 wt. % carbon and just below 1800°C between UC and tetragonal UC_2. It is presumed that the transformation of cubic UC_2 to tetragonal UC_2 occurs at about 9 wt. % carbon and 1820°C by a peritectoid-type reaction. (auth)

2256 HYDROGEN EMBRITTLEMENT IN VANADIUM–COLUMBIUM ALLOYS. A. L. Eustice and O. N. Carlson (Ames Lab., Ames, Iowa). Trans. Am. Soc. Metals, 53: 501-10(1961). (IS-126)

Hydrogen embrittlement in vanadium–niobium alloys was investigated as a function of alloy composition and hydrogen content. Bend and tension tests were carried out in the temperature range of −196 to +52°C. The temperature range of embrittlement was determined as a function of alloy composition and hydrogen concentration and the tensile properties of the alloys were measured as functions of composition and temperature. (auth)

2257 THE SOLID-STATE CONSTITUTION OF HIGH-URANIUM ALLOYS OF THE URANIUM–ZIRCONIUM–SILICON SYSTEM. M. S. Farkas, A. A. Bauer, and R. F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Soc. Metals, 53: 511-21(1961).

An investigation of high-uranium alloys of the uranium–zirconium–silicon system was conducted. Thermal analysis, metallography, and x-ray diffraction were used to construct isothermal ternary sections at temperatures from 550 to 950°C. No new ternary phase was encountered; however, extensive solution of zirconium in U_3Si_2 gives $(U,Zr)_3Si_2$. Otherwise the solubility of zirconium in uranium–silicon alloys is less than 2 at. %. Similarly the solubility of silicon in uranium–zirconium alloys is below 2 at. %. The addition of silicon to uranium–zirconium alloys is accompanied by the formation of Zr_2Si which alters the alloy constitution by removing zirconium from solution. Below 930°C, uranium–silicon-rich alloys with small amounts of zirconium contain the suitable allotropic form of uranium plus Zr_5Si_3 and U_3Si. The region $(U,Zr)_3Si_2$ plus U_3Si plus Zr_5Si_3 is also found. If larger amounts of silicon are present, the region $(U,Zr)_3Si_2$ plus U_3Si is stable. (auth)

2258 DIFFUSION OF CARBON IN THORIUM. David T. Peterson (Iowa State Univ. of Science and Tech., Ames). Trans. Am. Soc. Metals, 53: 765-73(1961).

The rate of diffusion of carbon in thorium was determined by measuring the fractional saturation of thorium cylinders at various times. The diffusivity at 1000°C was 7.4×10^{-9} cm^2/sec, at 1100°C was 2.8×10^{-8} cm^2/sec, and at 1200°C was 5.7×10^{-8} cm^2/sec. The activation energy for diffusion was 38 kcal per mole. Evidence of a change in the diffusivity with concentration was observed. (auth)

2259 NITROGEN ALLOYS OF THE T-METALS MANGANESE, IRON, COBALT, AND NICKEL WITH MAGNESIUM, ALUMINUM, ZINC, AND CADMIUM. Hans H. Stadelmaier and Tong S. Yun (North Carolina State Coll., Raleigh). Z. Metallk., 52: 477-80(July 1961). (In German)

Alloys in 13 ternary systems were investigated for the presence of cubic nitrides. Ternary nitrides with a lattice of the $L'1_2$ type were observed in the following systems: cobalt–zinc–nitrogen, nickel–aluminum–nitrogen, nickel–zinc–nitrogen. In addition, γ' iron nitride dissolves appreciable amounts of aluminium and zinc so that the homogeneity range of this phase is extended into the ternary system. A special case is observed in the system nickel–zinc–nitrogen where two cubic nitrides are found. The cobalt-rich compound in the binary system cobalt–magnesium is isotopic with the close-packed compound $MgZn_2$. (auth)

2260 MECHANICAL BEHAVIOR OF MATERIALS AT ELEVATED TEMPERATURES. John E. Dorn, ed. University of California Engineering Extension Series. New York, McGraw-Hill Book Company, Inc., 1961. 538p.

The basic principles of the dislocation theory are presented. The theory is also formulated to illustrate the application of the theory to the behavior of materials at elevated temperatures and for presenting an engineering background on some important topics on materials problems at elevated temperatures. (N.W.R.)

Radiation Effects

Refer also to abstracts 1964 and 1992

2261 (AERE-R-3752) DISLOCATION LOOPS AND IRRADIATION GROWTH IN ALPHA URANIUM. B. Hudson, K. H. Westmacott, and M. J. Makin (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 18p.

A successful electropolishing technique has been developed for preparing thin films of uranium with good transmission characteristics for electron microscopy. The technique has been applied to the study of irradiation damage in uranium, particularly the irradiation growth phenomenon. Dislocation loops are formed during neutron irradiation and analysis shows that these lie principally on {110} and {023} planes. In the absence of stacking fault contrast in the loops the most probable Burgers vectors are a {100} or $\frac{1}{2}\sqrt{(a^2 + b^2)}$ <110> for the {110} loops and $\frac{1}{2}\sqrt{(a^2 + b^2)}$ <110> for the {023} loops. These loops produce dimensional changes only in the directions of the macroscopic growth and contraction, [010] and [100] respectively. If it is assumed that the {023} loops are formed by interstitial atoms and the {110} loops by either interstitials or vacancies then the magnitude of the dimensional changes produced by the loops is in reasonable agreement with the macroscopic growth. It is concluded that the formation of the loops is the mechanism of the growth phenomenon. (auth)

2262 (AERE-R-3769) THE BEHAVIOR OF IRRADIATED BERYLLIUM. R. S. Barnes (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1961. 15p.

The nuclear transmutation of beryllium by fast neutrons adds an extra complication to the normal irradiation effects, caused by the displacement of atoms. Electron microscopic examination of thin films has shown that the helium atoms which are formed interact with clusters of displaced atoms and vacancies and precipitate as small gas bubbles which grow if further vacancies are available to them. These observations are used to explain the changes in mechanical properties and volume which occur in beryllium during irradiation or on subsequent heat treatment. Finally an attempt is made with the limited results available to suggest the likely behavior of beryllium as a reactor material. (auth)

2263 (GA-2229) IRRADIATION EFFECTS ON THE SURFACE REACTIONS OF METALS. Final Report, January 15, 1958 to January 15, 1961. W. L. Kosiba (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 3, 1961. Contract AT(04-3)-179. 70p.

The effects of reactor radiation on the surface reactions of metals and metal oxides in gaseous and aqueous media were investigated by comparing the reactions of unirradiated and irradiated polycrystalline copper specimens, as well as the reactions of unirradiated and irradiated copper single crystals, (111) face. The single-crystal and polycrystalline specimens, in inert atmospheres, were irradiated by exposure in the BNL, GETR, or TRIGA reactor to total integrated flux levels ranging from 10^{18} to 10^{20} neutrons/cm^2. In addition, the reaction rates of polycrystalline copper specimens in an oxygen atmosphere at a controlled temperature were also measured during irradiation (9.85×10^{16} neutrons/cm^2) in the TRIGA reactor. Determination was made of the reaction rates in a gaseous environment of unirradiated polycrystalline copper specimens as compared with that of specimens that were irradiated to various levels of radiation exposure, and also the reaction rates of polycrystalline copper specimens in a controlled-temperature oxygen atmosphere in the presence of radiation. Measurements were made of electrode potentials. Studies were made of the dissolution rates of irradiated and unirradiated polycrystalline copper and single crystals, (111) face, of copper in aqueous media. Observation was made of the formation of etch pits in irradiated and unirradiated copper single crystals, (111) face. It was found that the differences between the dissolution rates of both polycrystalline and single-crystal irradiated copper specimens as compared with unirradiated specimens were too small to yield definitive reaction-rate results. The gas-metal reaction experiments showed that irradiation does affect the oxidation rate of polycrystalline copper as compared with unirradiated copper; however, both increases and decreases in the rates of oxidation were found. Observation of etch-pit formation proved to be the most promising area of investigation: the radiation effects observed can be related directly to the magnitude of radiation exposure. (auth)

2264 (HW-64286) THE H-1 HIGH TEMPERATURE GRAPHITE IRRADIATION EXPERIMENT. J. M. Davidson and J. W. Helm (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AF(45-1)-1350. 50p.

A high temperature graphite irradiation experiment was performed in the GETR core to determine the effects of differences in manufacturing, formulation, and graphitization temperatures on radiation-induced contraction. The experiment was performed at temperatures of 800 to 1200°C in an intense fast neutron flux. The maximum integrated exposure of the sample positions was 3.2×10^{21} nvt, $E > 0.18$ Mev, corresponding to approximately 24,000 MWD/AT in a conventional graphite-moderated reactor. All the graphites tested, with the exception of the controls, were needle coke filler, coal tar pitch binder graphites varying in particle size, graphitization temperature, and impregnation. From theoretical and experimental considerations, the formulations and treatments were expected to result in a relatively stable graphite in the direction transverse to extrusion. For comparison of the experimental results to existing experience, a conventional graphite, CSF, was used at each irradiation position. The results showed that the graphite most stable to contraction was graphitized at a high temperature (>3100°C) and made from small particle size (all flour) filler. In all cases, the needle coke graphite contracted at a lower rate than the CSF graphite. Differences attributable to the size of extrusion and/or post graphitization cooling rate were discerned readily. Auxiliary to the purposes of the experiment, the apparent thermal neutron cross section for Co^{58} (plus Co^{58m}) was determined. Co^{58} and Co^{58m} are the products of the Ni^{58} (n,p) reaction, which is used widely for fast flux monitoring. Both have large thermal neutron capture cross sections which must be accounted for to prevent error in fast neutron dosimetry. In this experiment, a value was determined for the apparent burn-out cross section of 3750 barns. (auth)

2265 (HW-SA-47) AN X-RAY DIFFRACTION STUDY OF RADIATION DAMAGE IN MOLYBDENUM. W. V. Cummings, D. L. Gray, and J. D. Barnett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 12, 1959. Contract [AT(45-1)-1350]. 12p.

The study of irradiated molybdenum by x-ray diffraction is described. The reasons for the choice of molybdenum as the metal most likely to yield basic information about radiation damage are discussed. The specimen material used was commercially pure rolled molybdenum sheet. The specimens were irradiated in the Materials Testing Reactor to various total exposures to fast neutrons. Following discharge the specimens were prepared for x-ray-diffraction measurements of changes in lattice parameters, line widths, microstresses, fragmentation, and preferred orientation of crystallites. An analysis of the high angle diffraction line positions revealed an initial increase in lattice parameters with increasing exposure to fast flux until a maximum expansion of 0.048% was reached in the vicinity of 5.0×10^{18} nvt. For exposures greater than this, a reversion occurred that resulted in a contraction of the lattice. The broadening of the diffraction peaks was measured to obtain a preliminary measure of structure damage. (M.C.G.)

2266 (NP-10942) MONTHLY ACCESSION LIST NO. 51, [ON RADIATION EFFECTS DATA], SEPTEMBER 1—SEPTEMBER 30, 1961. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Oct. 15, 1961. 19p.

Annotated citations are given for 53 references to reports and published information on polymers, facilities, propulsion, dosimetry, ceramics, structural metals, organic and inorganic chemicals, space, electronics, health hazards, nucleonics, and fast-neutron scattering. (B.O.G.)

2267 (NP-10969) EFFECTS OF NUCLEAR RADIATION ON THE OPTICAL, ELECTRICAL AND THERMOPHYSICAL PROPERTIES OF SOLIDS: AN ANNOTATED BIBLIOGRAPHY. Robert C. Gex, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Aug. 1961. Contract AF04(647)-673. 241p. (SB-61-42)

Issued as an Addendum to the Space Materials Handbook.

Five hundred and seventy nine annotated references are presented on the effects of nuclear radiation on selected properties of a wide range of solid materials. The properties included are: optical absorptance, reflectance, transmittance and emittance; electrical resistivity and conductivity; refractive index; dielectric constant and strength; magnetic permeability; thermal conductivity; and heat capacity. The references are grouped into 6 broad subject categories: general and surface studies; metals and alloys; ceramics; plastics and other organic materials; alkali halides; and azides. The references are arranged by property affected and type of radiation within each category. There is an index to specific materials, e.g., copper, polyethylene, etc. Some studies of x rays are included. Several classes of solids are specifically excluded; silicon and germanium, compound semiconductors, and some other intermetallic compounds. The primary sources used for this compilation were: Radiation Effects Information Center accession list and Nuclear Science Abstracts. (auth)

2268 (ORO-494) MONTHLY NEWSLETTER [ON FUEL CYCLE DEVELOPMENT], AUGUST 1961. (National Carbon Co., Fostoria, Ohio). Sept. 20, 1961. Contract AT(40-1)-2560. 10p.

Progress is reported on the preparation of fueled graphite cylinders for the irradiation programs designated MTR-48-5 and MTR-48-6. Physical data for the fueled graphite cylinders and the graphite encapsulating assembly for MTR-48-5 are tabulated. Changes in the design of MTR-48-6 resulted in the use of pyrolytic carbon coated UC_2 fuel particles, in combination with an axial hole through the fueled-graphite compacts for measurement of central temperatures, and a 50% reduction in the power density of the compacts. (B.O.G.)

2269 (SRO-57) DELAMINATION OF KAOLIN BY HIGH-ENERGY IONIZING RADIATION. Final Report, April 1, 1959—March 31, 1961. William J. Corbett and John H. Burson, III (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Aug. 15, 1961. Contract AT(3801)-202. 67p.

The possibilities of reducing large particles of kaolin to small plate-like particles with high-energy, ionizing radiation, and the changes in the physical and colloidal properties of kaolin due to the effects of high-energy, ionizing radiation were investigated. Two different kaolins from the Cretaceous Tuscaloosa formation in Georgia were used in these studies. The kaolins differed in degree of crystallinity, particle size, and extent of processing before irradiation. Samples of these kaolins were exposed to doses of 0.667 Mev gamma radiation ranging from 10^{18} to 10^{22} ev/g. Significant changes were observed in the degree of crystallinity, specific surface area, cation exchange capacity, and slurry viscosity. Delamination of the larger particles into smaller platelike particles was detected for one of the samples, but not the other. Some unusual alterations in the appearance of the surface were found for a significant portion of the particles examined. Indications of a decrease in the ratio of hydrogen bonded to unbonded hydroxyl groups were detected by infrared absorption. Samples of irradiated kaolin appeared to grind more readily than did the unirradiated. The changes in physical and chemical properties are discussed in terms of the observed atomic displacements produced in the kaolinite structure by the gamma-radiation. Recommendations for future research are presented. (auth)

2270 (TID-13118) EFFECT OF RADIATION ON DYNAMIC PROPERTIES OF HIGH POLYMERS. Progress Report covering Period July 1, 1960 to June 30, 1961. J. A. Sauer (Pennsylvania State Univ., University Park). July 1, 1961. Contract AT(30-1)-1858. 25p.

Further studies were made of effects of radiation on polystyrene, polypropylene, polyethylene terephthalate, polytetrafluoroethylene, and epoxy resins. Measurements were also completed on the energy deposited by various components of reactor radiation and the data used to check earlier theoretical calculations. The relation between internal molecular mobility and polymer structure was further developed by study of the effects of changes in side branch length and stiffness in the poly-α-olefins, by study of the effects of water on the location of the glass transitions, and by study of some highly crystalline synthetic polypeptides. Nuclear magnetic resonance studies were made on polyethylene single crystals, some pure low molecular weight paraffins, and some substituted polystyrenes. Dielectric behavior was studied in several polyamides before and after irradiation and the apparatus for making simultaneous observations of dielectric data and thermal expansion further developed. Both experimental and theoretical work is reported on vibration and wave propagation in materials of various shapes such as rods and plates. (auth)

2271 (VDIT-16.3) RADIATION EFFECTS ON SOLID, URANIUM-BASED NUCLEAR FUEL MATERIALS SUPPLEMENT II. Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Oct. 1961. 39p.

A bibliography containing 75 abstracts on the radiation effects on solid uranium-based nuclear fuel materials is presented. Twenty-two access terms are included in the coordinate index. (M.C.G.)

2272 (AEC-tr-4669) LONG-LIFE STRENGTH OF COPPER AFTER IRRADIATION. A translation of "Izuchenie Dlitel'noĭ Prochnosti Medi Posle Oblucheniya." N. F. Pravdyuk and P. A. Platonov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 17p.

The results of the testing of the long-life strength of copper before and after irradiation are described. The dependence of the time-to-fracture on stress and on temperature in the range of 200 to 300°C before and after irradiation by a fast neutron flux of about 10^{20} n/cm^2 was determined. The activation energy of the fracture was determined. It was found that after irradiation at single energies of activation, the time-to-breakage increased substantially with respect to unirradiated copper. (auth)

2273 ISOTHERMAL MEASUREMENTS ON THE RELEASE OF STORED ENERGY IN IRRADIATED GRAPHITE. H. U. Astroem. Arkiv Fysik, 20: 161-75(1961). (In English)

The annealing of radiation defects in graphite irradiated to 10^{17} to 10^{19} neutrons/cm^2 was studied in the temperature range 70 to 340°C by means of an isothermal microcalorimetric method. The results include measurements of the energy given off due to recovery of the radiation damage, analysis of the kinetics of the annealing of the defects, and estimation of the energy of activation for the corresponding processes. The kinetics of the energy release was found to become more simple, the lower the irradiation dose and the lower the recovery temperature. The energies of activation decreased with decreasing dose. (auth)

2274 THE EFFECT OF NUCLEAR RADIATION ON THE PROPERTIES OF CONSTRUCTION STEEL. II. THE EFFECTS ON THE DESIGN AND MANUFACTURE OF REACTOR PRESSURE VESSELS. P. H. J. Simonis. Atomenergie, 3: 183-94(Sept. 1961). (In Dutch)

Theoretical considerations on the effect of ionizing radiation on the properties of construction steel for the pressure vessels of heterogeneous reactions are presented. There is a summary of the theories derived from experimental observations. (J.S.R.)

2275 THE EFFECT OF RADIATION ON THE ELECTRICAL PROPERTIES OF LITHIUM FLUORIDE. P. Bergé and G. Blanc (Centre d'Etudes Nucléaires, Saclay, France). Bull. soc. franç. minéral. et crist., 83: 257-64(1960). (CEA-1695) (In French)

A previously established technique for the measurement of the conductivity of non-irradiated lithium fluoride was applied to the study of the electrical behavior of samples irradiated with γ rays and thermal neutrons. Gamma irradiation decreases the conductivity. Thermal tempering, without apparently following any kinetics, can be explained in terms of an unstable complex formed by irradiation of the previously described couple Kg^{2+} with induced lithium defect. Neutron irradiation produces more complex effects which are seen above 10^{15} nvt as an increase in the conductivity and by a two-stage tempering effect. The first stage is accompanied by a decrease in the conductivity corresponding probably to the gradual elimination of excess carriers created by irradiation. The second stage corresponds to a return to the conductivity characteristics prior to irradiation by a mechanism liberating the carriers which are normally in thermodynamic equilibrium. (auth)

2276 EFFECT OF PRESSURE ON THE MODULUS OF RIGIDITY OF TWO BORON GLASSES IRRADIATED WITH THERMAL NEUTRONS. Christiane Susse and Jean Paymal (Centre National de la Recherche Scientifique, Paris) and Centre de Recherches de la Campagnie de Saint-Gobain, Paris). Compt. rend., 253: 792-4(July 31, 1961). (In French)

A resonance method was used to measure the modulus of rigidity up to 1000 kg/cm^2 of two glasses irradiated with thermal neutrons—a pyrex glass and a lead glass. The results obtained show the presence in the region of low doses of irradiation of a process which affects very slightly the moduli themselves and affects much more their derivatives with respect to the pressure. (tr-auth)

2277 EFFECT OF THE INTERNAL RADIATION PRODUCED BY TRITIUM IN LITHIUM FLUORIDE. Pierre Berge, Georges Blanc, and Monique Dubois. Compt. rend., 253: 847-9(July 31, 1961). (In French)

The irradiation of lithium fluoride by thermal neutrons produces the reaction $Li^6(n,\alpha)H^3$. The tritium released by this reaction remains for the most part in the crystals and causes an internal ionization which is shown by electrical and optical measurements. (tr-auth)

2278 ELECTRIC DISPERSION IN CRYSTALS OF LITHIUM FLUORIDE IRRADIATED BY NEUTRONS. Hubert Curien and Jeannine Fructus-Ricquebourg (Faculté des Sciences, Paris). Compt. rend., 253: 850-2(July 31, 1961). (In French)

In the frequency range from 50 to 100,000 Hz, a double electric dispersion can be shown in monocrystalline LiF foils irradiated with neutrons. Thermal treatments cause the evolution of one of the relaxation regions at the expense of the other. (tr-auth)

2279 LUBRICANTS FOR NUCLEAR REACTORS. [PART] I. P. E. B. Vaile (Mobile Oil Co., Coryton, Essex, Eng.). Engineer, 212: 610-11(Oct. 13, 1961).

The requirements for various reactor lubricants are discussed along with the effect of radiation on the lubricants. The requirements apply specifically to circulator oils, control rod mechanism greases, and general purpose radiation-resistant greases for carbon dioxide-cooled graphite-moderated reactors. Radiation effects on lubricating fluids and greases are described in terms of consistency, viscosity, and oxidation resistance. (N.W.R.)

2280 GAMMA-RAY INDUCED COLORING OF SOME PHOSPHATE GLASSES. Adli M. Bishay (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 44: 545-52(Nov. 1961).

The changes in gamma-ray induced optical absorption in phosphate glasses resulting from changes in composition, conditions during melting, and additions of small amounts of some oxides are discussed. A resolution of the induced spectra showed that the observed absorption is due to the superposition of three bands at 2.3, 2.9, and 5.5 ev (540, 425, and 225 mμ) and to a fourth band whose absorption peak is beyond 6 ev. The ultraviolet induced absorption increases, whereas the visible absorption decreases in glasses melted under reducing conditions as opposed to those melted under normal conditions in air and on replacement of K^+ by Na^+ or Li^+. A similar effect is produced on replacement of Ba^{2+} by Pb^{2+} and on the addition of Tl_2O to a $CaO \cdot P_2O_5$ glass or the addition of As_2O_3 to a $CaO \cdot P_2O_5 \cdot GeO_2$ glass. Additions of large amounts of GeO_2 are accompanied by a decrease in the number of nonbridging oxygens and a decrease in the visible induced absorption. Replacement of Ca^{2+} by Ba^{2+} ions showed an over-all decrease in the induced absorption. The addition of small amounts of the oxides of germanium, titanium, iron, thallium, niobium, and arsenic showed an appreciable effect in inhibiting the visible induced coloration. (auth)

2281 EFFECT OF GAMMA RADIATION ON SPECTRAL TRANSMISSION OF SOME COMMERCIAL GLASSES. R. S. Barker and D. A. Richardson (Pilkington Brothers, Ltd., Lathom, Lancs, Eng.). J. Am. Ceram. Soc., 44: 552-60(Nov. 1961).

An account is given of the effect of gamma radiation on the spectral transmission of certain commercial glasses. Curves are given showing the rate of fading of the coloration produced in these glasses by doses of gamma radiation in the range 10^4 to 10^8 rads. The effect on the optical density of some of these glasses by increasing doses of gamma radiation is discussed. (auth)

2282 RADIATION ENHANCEMENT OF BULK DIFFUSION IN 10% Zn-90% Cu BY 30-KEV Ne^+ ION BOMBARDMENT. R. A. Arndt and R. L. Hines (Northwestern Univ., Evanston, Ill.). J. Appl. Phys., 32: 1913-19(Oct. 1961).

Diffusion coefficients for the diffusion of zinc in 10% Zn–90% Cu single crystals are determined for both irradiated samples and unirradiated samples. This is accomplished by measuring the zinc lost from the samples when they are heated in a vacuum of 3×10^{-5} mm Hg at temperatures from 207 to 316°C. The zinc loss is measured by observing the change in optical reflection coefficient at a wavelength of 550 mμ. The diffusion length $(Dt)^{1/2}$ is then found using the known optical constants of ZnCu alloys and the expected concentration distribution. The diffusion lengths thus obtained range from 20 to 1000 A. Bombardment by a 30-kev Ne^+ ion beam of 2.9 $\mu a/cm^2$ produces defects at a calculated rate of 4.5×10^{-2} atomic fractions/sec over the depth of 300 A penetrated by the beam. For well-annealed samples the bombardment enhances the diffusion. The radiation-enhanced diffusion coefficient depends on the square root of the bombarding flux density and has an activation energy of 9300 ± 1700 cal/g mole. The results agree with theoretical predictions for enhanced bulk diffusion for the case of defects annealing by direct recombination plus linear anneal to fixed sinks. (auth)

2283 THE DEVELOPMENT OF CRYSTALLINITY AND TRANSPARENCY IN IRRADIATED POLYETHYLENE. Boris Levy (Westinghouse Electric Corp., East Pittsburgh, Penna.). J. Appl. Polymer Sci., 5: 408-23(July-Aug. 1961).

A procedure was developed for producing highly transparent polyethylene by using high-energy electron irradiation above the melting point. The polyethylene retains about 60% of its original tensile strength after receiving the optimum irradiation dose of 50 Mrad at room temperature followed by 50 Mrad at 150°C. The transparency of a 0.02 in. sample increases from about 20% to 75% under this treatment. Changes in transparency with time and temperature, during cooling of the polyethylene from 150°C to various quench temperatures, were investigated as a function of irradiation dose. The increase in transparency is a result of reduction in crystallinity, in size of crystallites and spherulites, and in rate of crystallization caused by the restraints imposed by the radiation-induced crosslinking. (auth)

2284 ON THE MECHANISM OF IONIZING RADIATION DAMAGE IN SBR ELASTOMERS. A. D. Delman, B. B. Simms, I. J. Stanley, A. E. Ruff, and E. Goldberg (New York Naval Shipyard, Brooklyn). J. Appl. Polymer Sci., 5: 501-9(Sept.-Oct. 1961).

Studies were made to provide information for use in the development of SBR elastomers with improved resistance to attack by high energy radiation. Changes of molecular structure were investigated by viscometric techniques and by measuring gel content. Chemical changes were followed by use of infrared spectrophotometry. Results indicate that the polymer in toluene, when subjected to radiation doses in the range 0–100 Mrep, is randomly scissioned. When similarly treated in chloroform, the polymer is initially randomly crosslinked and then the newly formed elastomer network undergoes random scission. The nature of the end chemical changes is shown to depend on environmental factors. In the presence of a limited supply of oxygen, the polymer is partially oxidized. The oxidation reaction appears to have no influence, however, on the random nature of the degradation process. The external butadiene structures are shown to be attacked more rapidly than the internal groups. The phenyl rings of the styrene groups in the polymer molecules, on the other hand, are only moderately affected in this respect. The results obtained are used to predict the effects of radiation damage to SBR vulcanizates. (auth)

2285 THE EFFECT OF RADIATION ON THE MELT INDEX OF POLYETHYLENE. II. EFFECT OF INITIAL POLYETHYLENE PROPERTIES. B. G. Harper (Dow Chemical Co., Freeport, Tex.). J. Appl. Polymer Sci., 5: 601-5(Sept.-Oct. 1961).

Nine different types of polyethylene were irradiated in air and their melt indexes determined as a function of radiation dose. Equations were derived which relate the melt index to the dose. The initial slopes of the curves represented by these equations were found to be related to the initial molecular weight and/or the initial crystallinity of the polyethylenes studied. A 1-Mev resonant transformer electronbeam generator was used as a source of radiation and cellophane dye dosimetry was used to determine the radiation dose. (auth)

2286 PHOTOCONDUCTION OF γ-RAY IRRADIATED KCl SINGLE CRYSTALS AT HIGHER ELECTRIC FIELD. Yoshio Inuishi and Yung-Kwun Sung (Osaka Univ.). J. Phys. Soc. Japan, 16: 2074-5(Oct. 1961). (In English)

Mechanisms of gamma coloration effects on KCl dielectric strength were investigated in connection with pulse photoconduction at prebreakdown range. It was found that mobility lifetime increases, due to mobility increase, and that saturation fields decrease, with decreasing temperature. At prebreakdown field, charge multiplication occurs. The quantum yield apparently shows a remarkable increase above −60°C. (L.N.N.)

2287 MECHANICAL EFFECT OF X RADIATIONS ON CRYSTALS. Walter Gorski (Max-Planck-Gesellschaft, Göttingen, Ger.). Naturwissenschaften, 48: 519-20(1961). (In German)

Recent evidence seems to suggest that the mechanism of radiation hardening corresponds to a type of precipitation hardening. A comparison between plastic and radiation hardening clearly indicates the interaction of two different types of mechanisms. If plastic hardening is added to a previously radiation-hardened sample, the Vickers values increase over 100%. (J.S.R.)

2288 CALCULATION OF THE REPLACEMENT EFFECT IN THE STATISTICAL THEORY OF LATTICE DAMAGE. G. Németh (Central Research Inst. for Physics, Budapest). Nuovo cimento (10), 21: 764-72(Sept. 1, 1961). (In English)

Calculations are made on the number of instances of lattice damage due to irradiation by high energy particles. Using the assumption that the atoms responsible for the displacements due to collision may be captured in the lattice sites of the displaced atoms, the capture probability is written in the exponential form exp $[-\alpha(E/E_d)]$ and the average number of instances is obtained as $m_\lambda(E) \sim K(\alpha)[(E/E_d) + 1]$. (auth)

2289 ION DAMAGE TO METAL FILMS INSIDE AN ELECTRON MICROSCOPE. D. W. Pashley and A. E. B. Presland (T. I. Research Labs., Cambridge, Eng.). Phil. Mag. (8), 6: 1003-12(Aug. 1961).

The origin of small spot and loop features observed in electron micrographs of thin evaporated single-crystal gold films was investigated. It is found that the features are introduced into the specimens while being examined in the electron microscope. Conclusive evidence is given to show that they arise from bombardment by energetic negative ions emitted from the tungsten filament of the electron gun, although the ions were not identified. The rate of ion damage can be considerably increased by coating the tungsten filament with a standard oxide emitter. Annealing characteristics of the damage were studied. Above about 300–350°C the majority of the spot features anneal out, and ion damage above about 350°C consists of the formation of small tetrahedra of stacking fault. The ion damage is assumed to be very similar in character to that produced by primary knock-ons resulting from irradiation by other particles (e.g., neutrons). (auth)

2290 THE PLASTIC DEFORMATION OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. Uwe Essmann, Siegfried Mader, and Alfred Seeger (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Z. Metallk., 52: 443-54(July 1961). (In German)

The work hardening behavior and the surface phenomena of copper crystals irradiated with a neutron dose of $2 \times 10^{17}/cm^2$ fast neutrons were tested by tensile deformation at 90, 293, and 513°K and compared to the behavior of unirradiated crystals. The greatest differences between irradiated and unirradiated crystals occur at small strains. The critical shear stress increases with decreasing temperature as reported by other authors. Then follows a stage of discontinuous flow characterized by the formation of Lüders bands and no increase in work hardening. The total strain of this stage increases with decreasing temperature. In this stage, slip bands are formed consisting of about 50 single slip lines due to electron microscope evidence. In stages II and III of the stress strain curve the work hardening rate is less than in unirradiated crystals. In stage II the rate is independent of temperature. The stress at the beginning of stage III decreases with increasing temperature. The axis of tension overshoots markedly across the symmetrical position. In stage II clusters of new slip lines are formed at first between the slip bands of the Lüders bands; with increasing strain the slip line pattern resembles the structurized fine slip of unirradiated crystals. The reciprocal length of newly formed slip lines increases linearly with shear stress and shear strain, respectively. The newly formed slip lines are shorter than those formed under comparable conditions on unirradiated crystals. In stage III slip bands occur with cross slip between the individual fragments as in unirradiated crystals. An interpretation is given in terms of specific lattice defects formed by neutron irradiation. The interaction of these defects with dislocations and the reduction of the defects during the plastic deformation account for the special features of radiation hardening. (auth)

2291 RADIATION-INDUCED DISORDER IN SEMICONDUCTORS. J. W. Cleland and J. H. Crawford, Jr. (Oak Ridge National Lab., Tenn.). 4p. from "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960."

The variation of σ and μ_H of n-type Ge with neutron bombardment was treated on the basis of a disordered-region model of lattice damage. It is found that the bulk of the initial change in these properties can be accounted for in terms of disordered regions ~100 Å in radius for the neutron spectrum employed. (auth)

PHYSICS

General and Miscellaneous

Refer also to abstracts 1732 and 2768

2292 (AD-256654) NONLAMINAR ELECTRON STREAMS. Technical Report No. 47. Murray H. Miller (Michigan. Univ., Ann Arbor. Electron Physics Lab.). Mar. 1961. Contract DA36-039-sc-78260. 46p. (ORA-02854-13-T)

Rectilinear and axial Brillouin flow is discussed without a restriction to laminar motion. The sensitivity of the d-c characteristics of these flows to a small amount of nonlaminarity is calculated. Calculations are made of the characteristics of space-charge wave propagation on a nonlaminar rectilinear flow, and compared with the laminar results. (auth)

2293 (AFCRL-285) RADIATION STUDIES FROM NUCLEAR EMULSIONS AND METALLIC COMPONENTS RECOVERED FROM POLAR SATELLITE ORBITS. GRD Research Notes No. 54. Herman Yagoda (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). Mar. 1961. 32p. (AD-255662)

Two blocks of Ilford G5 emulsion measuring 10 × 15 cm and each weighing 772 ± 2 g were recovered from polar satellite orbits. The one launched on Discoverer XVII was exposed to the intense solar radiation associated with the 3+ flare of November 12, 1960. By means of a special developing technique conducted at pH 6.50, which resulted in a 30-fold reduction in grain growth, it was possible to suppress the intense background of solar protons and discern the tracks of very highly charged heavy primary nuclei that stopped by ionization in the emulsion. The frequency of this category of particles with charges $Z \geq 11$ was estimated at 13 ± cc^{-1} day^{-1}. A similar measurement on the Discoverer XVIII emulsions, which were placed in orbit on December 7, 1960 during a period of relatively normal solar activity, yielded a termination rate for nuclei with charges $Z \geq 6$ of 8.65 ± 0.93 cc^{-1} day^{-1}. These measurements indicated that the flux of the heaviest galactic primaries remained essentially unaltered during the giant solar flare. Examination of the flare-irradiated emulsions at very high magnification showed the presence of a much larger flux of nuclei which appear to be of charge $Z = 6 \pm 2$ on the basis of tentative ionization-range identifications. A comparison of the Discoverer XVIII emulsion measurements with data from a balloon flight at 140,000 ft elevation, launched at Minnesota on July 29, 1960 and which recorded 7.8 ± 1.2 heavy primary terminating tracks cc^{-1} day^{-1}, indicated that the flux of slow heavy primaries does not increase appreciably while the satellite is orbiting over the polar regions during quiescent solar conditions. Preliminary estimates of star production in the Discoverer XVIII emulsions showed that nuclear disintegrations with three or more associated tracks accumulate with a frequency of about 6700 ± 500 cc^{-1} day^{-1}. This was about twice as large as could be anticipated from counter data and emulsions flown in rockets from sites whose geomagnetic latitudes extended between the equator and the polar regions. The slope of the integral star prong spectrum indicated a component of low energy star-producing radiation which probably originates in the fringes of the lower Van Allen belt that the satellite grazed during apogee. The aluminum, iron, and lead inside the satellite capsules are being analyzed by radiochemical techniques for long-lived radioactive spallation products. Preliminary reports indicated greatly increased yields of radionucleides in the metallic components of the satellite capsule exposed to the flare as compared with iron and stone meteorites. The yield of tritium was particularly high and the ratio of H^3/Ar^{37} observed suggested that primary tritium nuclei may be accelerated during the 3+ solar flare. (auth)

2294 (AFOSR-1186) THE SCATTERING OF MICROWAVES FROM MULTIPLE SPHERES. K. A. Moe and D. J. Angelakos (California. Univ., Berkeley. Electronics Research Lab.). June 2, 1961. Contract AF49(638)-1043. 42p.

The scattering of microwaves from certain types of arrays of spheroids was previously studied and a method of calculating the back scattered energy was developed. This information was extended to the case in which the spheres have merged to a single sphere. Supplementary data were collected which allow the determination of the relative back scattered energy for all angles of incidence. Theoretical considerations, experimental techniques, and procedure are discussed. Results are presented in graphical form. (M.C.G.)

2295 (K-1464) THE EFFECT OF SURFACE FLOW ON THERMAL TRANSPIRATION IN POROUS MEDIA. E. N. Lassettre and A. A. Brooks (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 10, 1961. Contract W-7405-eng-26. 35p.

In finely porous media at low temperatures it is known that gas transport occurs both through the gas phase and in the surface film. When such a medium is subject to a temperature gradient and both ends are blocked to prevent any net gas flow, then either the surface and gas phase flow rates both vanish, or, alternatively, the two are nonvanishing and oppositely directed. A theoretical study of the low pressure case, when the surface coverage is also low, leads to the conclusion that countercurrent flow rates of considerable magnitude must arise. Arguments are advanced for believing that such flows arise for condensed films as well. (auth)

2296 (K-1495) TRIP REPORT ON INTERNATIONAL CONFERENCE ON SPECTRAL LINE SHAPE AND MOLECULAR INTERACTIONS, REHOVOTH, ISRAEL, AND VISITS TO SEVERAL EUROPEAN LABORATORIES. DeForest F. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 22, 1961. Contract W-7405-eng-26. 19p.

The recent conference on Spectral Line Shape and Molecular Interactions held at the Weizmann Institute of Science, Rehovoth, Israel is discussed. Observations were made on a brief visit to the heavy oxygen plant at the Weizmann Institute, and of visits to eight European laboratories made subsequent to the conference. With the exception of the University of Bonn, where the mass filter development of W. Paul was the main interest, the laboratories have research programs involving infrared spectroscopy. (auth)

2297 (K-1496) TRIP REPORT ON INTERNATIONAL CONFERENCE ON MAGNETISM AND CRYSTALLOGRAPHY, KYOTO, JAPAN, AND VISITS TO FOUR JAPANESE LABORATORIES. Warren W. Harris (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 22, 1961. Contract W-7405-eng-26. 13p.

A report is given of the Electron Diffraction Meeting of the International Conference on Magnetism and Crystallography held at Kyoto, Japan, September 25 to 30, 1961, and of visits to four university laboratories and to the Japan Electron Optics Factory and Development Laboratory. With the exception of Rikkyo University, where nuclear physics is the main interest, the laboratories were actively engaged in electron diffraction theory or design of electron optical instruments. (auth)

2298 (KR-10) QUARTERLY PROGRESS REPORT, APRIL 1–JUNE 30, 1961 [ON RESEARCH ACTIVITIES]. (Norway. Institutt for Atomenergi, Kjeller). Sept. 1961. 65p.

Activities at the Institutt for Atomenergi are summarized. Progress in reactor development, neutron physics, fuel element development, fuel reprocessing, analysis techniques, and isotope production and development is reported. Safety measures are reviewed. (M.C.G.)

2299 (NP-10971) SPUTTERING: A BIBLIOGRAPHY OF THEORY AND EXPERIMENTAL RESULTS. W. L. Hollister, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Aug. 1961. Contract AF 04(647)-673. 30p. (SB-61-47)

Sixty references on cathode, ion, and particle sputtering are given to books, reports, and U. S. and foreign journals from February 1954 to June 1961. (P.C.H.)

2300 (TID-14182) SOLID STATE PHYSICS PROGRAM. Annual Progress Report. (Case Inst. of Tech., Cleveland). Nov. 1, 1961. Contract AT(11-1)-623. 17p.

Progress is reported of research being conducted in thin film physics, cohesive properties, and solid state theory. (D.L.C.)

2301 (TID-14228) TECHNICAL REPORT NO. 1 [ON CRYSTALS]. R. O. Simmons (Illinois. Univ., Urbana). Oct. 1961. Contract AT(11-1)-971. 10p.

Work is being carried out on the preparation of pure crystals of neon and argon. A first model cryostat assembly was designed, constructed, and put into service. Extensive investigations were made of the properties of various thermometric alloys, wire sizes, and junction fabrication methods for the measurement of temperatures in the range from 4 to 100°K, and for the determination of small temperature differences in the same range. The problem of obtaining relatively accurate lattice parameter measurements from a single-crystal whose position may be rather uncertain was examined both by computational analysis and by experiment. It was concluded that the most promising methods employ high-angle Laue-Bragg diffraction maxima and a rotated crystal. Experimental studies of subgrain content were made near room temperature on gold crystals prepared by a variety of methods. A gas handling and purification system was developed. An x-ray goniometer was designed and adapted to the requirements of a sample fixed in a cryostat. (M.C.G.)

2302 (TID-14230) THEORY OF THERMAL EXPANSION AT LOW TEMPERATURE; SOLID STATE PHYSICS PROGRAM. Raymond D. Mountain (Case Inst. of Tech., Cleveland). May 1961. Contract AT(11-1)-623. 32p.

An expression for the volume coefficient of thermal expansion β is derived from Debye theory. The expansion coefficient at low temperatures is found to be proportional to the absolute temperature cubed and to the change in the Debye temperature with pressure. A comparison is made with Grüneisen's relation and the expression for β is shown to be equivalent to it. A negative value of β is found to indicate an increase with pressure in the number of low frequency modes per unit frequency interval excited in the lattice. The expansion coefficients for NaCl, KCl, and Si are calculated using the de Launay and the Alberta methods to determine Debye temperatures. The expansion coefficient for NaCl is positive and the results of the two methods are in reasonable agreement. The expansion coefficient for KCl is positive using the de Launay method and negative using the Alberta method. For Si β is negative using the de Launay method and positive using the Alberta method. Since the de Launay method is a more detailed approximation than the Alberta method, the results obtained using it are felt to be the more reliable ones. (auth)

2303 (UCRL-6473) ANNOTATED BIBLIOGRAPHY OF THEORIES OF THE EQUATION OF STATE OF IONIZED GASES AND STRONG ELECTROLYTE SOLUTIONS. Stephen G. Brush and Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 8, 1961. Contract W-7405-eng-48. 74p.

This bibliography lists 297 references on the equation of state of ionized gases and electrolyte solutions, including calculations of closely related quantities such as free energy, partition functions, osmotic pressure, activity coefficients, and equilibrium compositions of partially ionized systems. A subject index and a supplementary list of 42 bibliographies on plasma physics and similar topics are included. (auth)

2304 (UCRL-6594) HALL EFFECT MEASUREMENTS. A Bibliography covering the Period 1955 through April 1961. Rose Kraft (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 21, 1961. Contract W-7405-eng-48. 40p.

A bibliography covering 447 references on (1) Hall Effect measurements: techniques, equipment, and results of measurements on semiconductors and dielectric materials; and (2) electrical resistivity and conductivity of oxide materials: techniques, equipment, and results. The references are arranged alphabetically by authors. (M.C.G.)

2305 (UCRL-9704) PHYSICS DIVISION SEMIANNUAL REPORT, NOVEMBER 1960 THROUGH APRIL 1961. (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 83p.

Development and operation of liquid hydrogen bubble chambers are discussed. The following investigations are summarized: particle interactions; search for Dirac monopoles; strange-particle research; spark chamber developments; emulsions; electron linear accelerators; particle production and scattering; charge independence; and space physics. Theoretical studies are described for: the physics of the nucleus; strong and weak interactions; mesons-π and -μ; field theory; atomic, high-energy, and plasma physics; and accelerators. Computer programs written for various applications are described. The operation of the 60-Inch Cyclotron is summarized. (B.O.G.)

2306 (AEC-tr-4141) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Selected Articles from Nukleonika, 2: No. 2(1957). 110p.

Five selected papers from Nukleonika are presented. Topics covered include basic problems of nuclear power, accelerators, construction of Geiger-Mueller counters, distribution of charge in atomic nucleus, and discovery of the antineutron. A chronicle of events and news is also presented. A separate abstract was prepared for one paper. Four were previously abstracted in NSA. (M.C.G.)

2307 (AEC-tr-4721) DISTRIBUTION OF ALTERNATING MAGNETIC FIELD IN BULKY SINGLE-TURN COILS. A translation of "Raspredelenie Peremennogo Magnitnogo

Polya v Massivnykh Odnovitkovykh Katushkakh." B. G. Safronov, V. A. Churaev, Yu. S. Azovskii, G. G. Aseev, and V. S. Voitsenya (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 28p.

The magnetic field distribution in bulky single-turn coils was determined at current frequencies of 50 cps and 200 kc. The effect of a longitudinal cut through the coil for feeding current to the coil on the distribution was also determined, and means for eliminating this effect are discussed. Three possible ways of using a single-turn coil to produce magnetic fields with mirror geometry are considered. Finally, the magnetic field at the center of the coil is calculated approximately. (D.L.C.)

2308 (UCRL-Trans-730(L)) THEORETICAL STUDIES ON STRONG SPHERICO-SYMMETRICAL CONVERGENT COMPRESSION SHOCKS IN DEUTERIUM GAS. H. Voelcker. Translated by M. S. Little (Univ. of California Lawrence Radiation Lab., Livermore) from Atomkernenergie, 5: 209-17(June 1960). 32p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 18262.

2309 DECAY-TIME OF SCINTILLATIONS IN CsI (Tl) CRYSTAL. N. P. Sastry and B. V. Thosar (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 54: 140-5(Sept. 1961). (In English)

Decay times of scintillations excited in a CsI(Tl) crystal by α particles and γ rays were studied for the two regions of the emission spectrum, blue and yellow. Voltage pulses from a photomultiplier tube, as seen on a high-speed oscilloscope, were photographed and investigated. There are two decay components, short- and long-lived. In the case of the long-lived component ($\tau = 10\ \mu$sec) there is no significant variation in decay time with the nature of excitant or the type of emission band. For the short-lived component there is no variation with the type of emission band, but a marked decrease in the decay time for α excitation ($\tau = 0.5\ \mu$sec) compared to that for γ rays ($\tau = 0.9\ \mu$sec) was found. (auth)

2310 THE SENSITIVITY OF THE CORRECTION FOR EXTINCTION IN CRYSTALS USING POLARIZED X-RAYS AND NEUTRONS. P. Szabo (McMaster Univ., Hamilton, Ont.). Acta Cryst., 14: 1206-7(Nov. 10, 1961).

Chandrasekhar's method of correcting x-ray structure factors for extinction in crystals and the extension of the method by Chandrasekhar and Weiss to cover the extinction correction of neutron magnetic structure factors are discussed in terms of the sensitivity of the method. The methods show that sensitivity depends not only on the values of the structure factors but also explicitly on Θ. It is also shown that the extinction is restricted to a part of the measurable reflections. (N.W.R.)

2311 EFFICIENCY OF THERMOELECTRIC DEVICES. Eric T. B. Gross (Illinois Inst. of Tech., Chicago). Am. J. Phys., 29: 729-31(Nov. 1961).

The known expressions for efficiencies of thermoelectric energy converters can be so modified that the Carmot efficiency η_c of the ideal heat engine cycle appears as one of two significant parameters. The other parameter ZT (Z = figure of merit, T = hot spot temperature in °K) is a significant characteristic of the thermoelectric material used in the device. The use of these parameters leads to a realistic evaluation of presently possible efficiencies under ideal conditions. (auth)

2312 PHYSICAL NATURE OF SHOCK PROPAGATION. William Band (Washington State Univ., Pullman) and George E. Duvall. Am. J. Phys., 29: 780-5(Nov. 1961).

An elementary discussion of the basic concepts required for an understanding of shock wave propagation is given. Derivations are presented for the Rankine–Hugoniot relations, Bethe's stability condition, Earnshaw's relation, and the structure of the shock front or shock profile. (auth)

2313 ELECTRON DISTRIBUTION FUNCTION OF A WEAKLY IONIZED GAS IN MAGNETIC AND TIME-DEPENDENT ELECTRIC FIELDS. Jonas S. Zmuidzinas and Ching-Sheng Wu (California Inst. of Tech., Pasadena). Ann. Phys. (N. Y.), 15: 387-402(Sept. 1961).

An investigation is made of the electron behavior in a weakly ionized gas in a magnetic field and arbitrarily time-dependent electric field. This problem is of interest either in astrophysics or the study of the basic phenomena in gas discharge. The electron distribution function is studied based on the Boltzmann equation which takes only the electron-atom collisions into account. A "moment method" is devised to solve the case when the electron collision frequency is uniform. In the subsequent analysis, the electron distribution function is first expanded in terms of both the "moments" and the associate Laguerre polynomials and then a generating equation of the moments is derived. This generating equation which is linear and of first order in time can be integrated readily. The persistent solution is obtained in closed form for the quasi-steady case. In case of high-frequency oscillating electric field the drift velocity, the mean energy, the conductivity and the dielectric constant are all discussed. (auth)

2314 THEORY OF COLLISION TRANSFER OF EXCITATION IN HELIUM. Chun C. Lin and Richard G. Fowler (Univ. of Oklahoma, Norman). Ann. Phys. (N. Y.), 15: 461-9(Sept. 1961).

A theory is presented to explain the multiple state mechanism for the transfer of excitation from singlet to triplet states in helium atoms proposed by St. John and Fowler. The spin-orbit interactions produce substantial singlet-triplet mixing in the F states which is responsible for the transfer. It is shown that a helium atom in an n^{1}P state, after colliding with a normal atom, transfers primarily into the "mixed" nF states which in turn cascade to 3^3D. The population of the 3^3D state is calculated as 4.0×10^5 atoms/cm^3 as compared to 1.28×10^5 atoms/cm^3 from experiment. (auth)

2315 DETERMINATION OF ELECTRON DENSITY AND MOBILITY IN SLIGHTLY IONIZED CESIUM. George J. Mullaney and Norman R. Dibelius (General Electric Co., Schenectady, N. Y.). ARS (Am. Rocket Soc.) J., 31: 1575-6(Nov. 1961).

A probe technique is discussed, and diagrams of the apparatus and of the concentric electrode conductivity all are given. After loading the cell with 50 mg Cs, it was placed inside an electric furnace and heated to 1125°K. Electric conductivity was measured directly, and $\omega_e\tau_e$ in which ω_e is the electron cyclotron frequency and τ_e is the time interval between electron collisions with neutral gas in the plasma, was subsequently calculated. The most important uncertainty is the Cs pressure. A large portion of the Cs was absorbed by or chemically reacted with the walls at the experimental temperatures. (L.N.N.)

2316 MAGNETO-OPTICAL PROPERTIES OF GADOLINIUM. Michel Auphan (Laboratoires d'Électronique et de Physique appliquée, Paris). Compt. rend., 253: 398-9(July 17, 1961). (In French)

The constant of the Kerr magneto-optical effect for gadolinium was measured, and the results show that the effect progressively disappears when the temperature is increased. (J.S.R.)

2317 NEUTRALIZATION OF A BEAM OF IONS BY INJECTION OF ELECTRONS. SOLUTIONS INDEPENDENT OF TIME. Jean-Michel Dolique. Compt. rend., 253: 818-20(July 31, 1961). (In French)

The realization of an ion beam, neutralized by electron injection, is capable of a large number of very interesting practical applications: propulsion of rockets, injection in a magnetic bottle with respect to thermonuclear fusion, plasma accelerator, etc. Experimentally, the obtention of a mixed stable beam, with great intensity, offers great intensity, offers great difficulties; therefore, there is interest in the theoretical study of the problem. A more perfect model than those envisaged up to the present is developed. (tr-auth)

2318 INITIAL RESULTS OBTAINED WITH A SOURCE OF NEGATIVE HYDROGEN IONS USING CHARGE EXCHANGE ON THE GAS. Alain de Chateau-Thierry. Compt. rend., 253: 821-3(July 31, 1961). (In French)

A source of H^- ions, which utilizes charge exchange of positive hydrogen ions on a gas (hydrogen or argon), is described. This apparatus permits the obtention of 3 μamp of H^- ions, the yield of exchange being of the order of 3%. (tr-auth)

2319 HIGH RESOLUTION TIME-OF-FLIGHT SPECTROMETRY OF INTERMEDIATE NEUTRONS. Charles Corge, Vinh-Dinh Huynh, Jean Julien, Joseph Morgenstern, and Francis Netter (Centre d'Études Nucléaires, Saclay). Compt. rend., 253: 859-61(July 31, 1961). (In French)

The experiments made with the Saclay linear accelerator have permitted a resolution of 1 mμsec/m to be attained in the study of a screen of U^{238} by time-of-flight of neutrons with energy between 1 and 3.5 kev. Some experiments with a resolution of 2.5 mμsec/m have shown new resonances for As, Zr, and Pr. (tr-auth)

2320 RADIOLUMINESCENCE FROM BETA RADIATION. FURTHER EXPERIMENTAL RESULTS. M. Serra and A. Del Monaco (Università, Rome). Energia nucleare (Milan), 8: 566-70(Sept. 1961). (In English)

The influence of certain parameters on the emission of light by fluorescent salts excited by β radiations and the determination of the optimum value for the thickness of salt for a β source consisting of promethium-147 is discussed. The measured radiances and efficiencies, which are found to be of the order of 25 lumen/watt, are given for various samples. (auth)

2321 UNSTEADY MOTION IN NON-IDEAL MAGNETIC HYDRODYNAMICS. V. S. Tkalich. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr., No. 5, 22-9(Sept.-Oct. 1961). (In Russian)

A system of four scalar equations was derived for determining the functions of currents and third components of velocity and magnetic field in the presence of physical functions from the two curvilinear coordinates and time. The results were correlated with data obtained by other methods. In Decart coordinates only the two-scalar equation system for current functions, was nonlinear. A series of precise solutions, expressed by the solution of Helmholtz heterogeneous equations, fulfilling the principle of superposition was indicated. (R.V.J.)

2322 EMISSION OF POLARIZED BEAMS OF SINGLE-ELECTRON ATOMS. A. S. Stepanov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 35-41(1961). (In Russian)

Quantum dynamics were used for calculating the absolute magnitude of single-electron-atom emission intensity. Polarization is investigated as a function of the angle of observation. The results are used in setting up experiments with polarized atomic beams. (tr-auth)

2323 REFLECTION OF AN ELECTRON BEAM FROM HIGH-FREQUENCY FIELDS. R. B. Hall and Sanborn C. Brown (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 32: 1835-6(Oct. 1961).

Experimental verification of time-average forces due to an r-f field acting on charged particles is obtained by measuring the transmission of an electron beam through the high-frequency fields of a cavity. By adjusting the external d-c magnetic field so that cyclotron resonance is approached, it is possible to reflect high-energy beams; that is, 66 w of microwave power completely reflected a 24-v beam. Agreement between experiment and theory was close. (auth)

2324 BEHAVIOR OF EXPLODING GOLD WIRES. T. J. Tucker (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys., 32: 1894-1900(Oct. 1961).

A square-wave generator current source is used to study the behavior of gold wires exploded by current densities in the range of 0.25×10^8 to 3.26×10^8 amp/cm^2. Measurements of wire resistance vs cumulative energy and action at various current densities are compared with a simple theoretical exploding wire model and the results of Kerr cell photographic studies. Experimentally, the total energy input to the time of maximum wire resistance increases with current density and may exceed by threefold the normal vaporization energy. Also, the instantaneous wire resistance at any point is smaller with a larger current density. The resistance depression is first apparent in the region following vaporization. At higher current densities, the effect is observed to occur at progressively earlier phases up to and including the point at which melting occurs. (auth)

2325 OPEN CIRCUIT VOLTAGES IN THE CESIUM DIODE. Fred N. Huffman (Martin Co., Nuclear Div., Baltimore, Md.). J. Appl. Phys., 32: 1927-32(Oct. 1961).

A plasma model and a close-spaced model are used to analyze the detailed variation of the open circuit voltage of the cesium diode. The plasma model open circuit voltage expression is compared to one derived by Lewis and Reitz in which the ion contribution to the net electron current is neglected. For either model the main features of the open circuit voltage at emitter temperatures less than 1800°K arise from the complex ion and electron emission properties as a function of emitter temperature and cesium pressure. Although at higher emitter temperatures the plasma model open circuit voltage becomes independent of the detailed surface characteristics of the emitter, the two models continue to give similar numerical results. Calculations based on these models and incorporating the data of Langmuir agree qualitatively with the sinusoidal and discontinuous open circuit voltage variations observed by Pidd, as well as the anomalous load characteristic observed by Wilson. (auth)

2326 ALTERNATING CURRENT MAGNETOHYDRODYNAMIC GENERATOR. P. R. Smy (Univ. of British Columbia, Vancouver). J. Appl. Phys., 32: 1946-51(Oct. 1961).

The design criteria of a proposed a-c magnetohydrodynamic (mhd) generator are discussed. It is found that electrical losses to the moving fluid are serious unless the duct length-to-width ratio is greater than about 30. Two developments of such a generator are suggested. The first would provide a solution to the problem of power output from a segmented-electrode generator. The second development, that of capacitive power transfer at the electrode-fluid interface, would have many benefits, but its application is found to be severely restricted by the limited dielectric strength of materials. (auth)

2327 EFFECT OF ELECTRON BOMBARDMENT ON THE NEAR-INFRARED FLUORESCENCE OF SINGLE-CRYSTAL CdS. B. A. Kulp (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). J. Appl. Phys., 32: 1966-9 (Oct. 1961).

Under electron bombardment at 40°C, two fluorescence bands in the near infrared are observed in many CdS crystals. The bands are at about 8500 A and 1.05 μ. The 8500-A band is reduced in intensity by electron bombardment at 100 and 275 kev and by exposure to x radiation. The 1.05-μ band is not greatly affected by these irradiations. Heat treatment for ½ hr at 200°C partially restores the 8500-A band. The effect is interpreted as a redistribution of electrons over the existing defects. The defect responsible for the 8500-A band is believed to be copper in a particular ionization state. The 1.05-μ band is observed to appear after heat treatment at 200°C if it is not present originally. This fact makes the origin of this latter band uncertain. (auth)

2328 CONDUCTIVITY OF SEEDED ATMOSPHERIC PRESSURE PLASMAS. L. S. Frost (Westinghouse Research Labs., Pittsburgh). J. Appl. Phys., 32: 2029-36 (Oct. 1961).

The electrical conductivity is calculated for some typical seeded gases of magnetohydrodynamic interest. The electron density is obtained using Saha's equation. A method is developed for calculating electron mobility in gas mixtures, taking account of the variation of the scattering cross section with energy. Scattering by ions is also considered. Results are presented for several gases seeded with small amounts of Cs or K in the temperature range from 2000 to 4000°K. (auth)

2329 THERMIONIC EMISSION FROM SPHERICAL METALLIC PARTICLES. M. S. Sodha (Armour Research Foundation, Chicago). J. Appl. Phys., 32: 2059-60(Oct. 1961).

An expression is derived for the rate of thermionic emission from a charged spherical metallic particle (where the free electron theory is applicable). This expression is used to investigate the charging of particles when no space charge is present around the particles. (N.W.R.)

2330 CALCULATION OF POLARIZABILITIES AND SHIELDING FACTORS. A. Dalgarno and J. M. McNamee (Queen's Univ., Belfast). J. Chem. Phys., 35: 1517-18 (Oct. 1961).

The dipole and quadrupole polarization of beryllium Be ($1s^2\ 2s^2$) is calculated using the unperturbed Hartree-Fock 2s orbital $u^{(0)}(r \mid 2s)$ and the perturbed Hartree-Fock 2s orbital $u^{(1)}(r \mid 2s)$. The effects of the approximation in calculations of the dipole polarizability, the electric field strength at the nucleus, the quadrupole polarizability, and the nuclear shielding factor γ_∞ are tabulated. (P.C.H.)

2331 PARAMAGNETIC RESONANCE OF X-IRRADIATED CaF_2: Tm AND OF CaF_2: Yb. W. Hayes and J. W. Twidell (Clarendon Lab., Oxford). J. Chem. Phys., 35: 1521-2(Oct. 1961).

Measurements on CaF_2: Tm III are reported, and measurements on CaF_2: Yb IV are included for comparison. The crystals were x irradiated at 77°K and the ESR spectrum investigated without allowing the crystals to warm up. The spectrum is assigned to Tm^{169} III which is isoelectronic with Yb IV ($4f^{13}\ {}^2F_{7/2}$). This result shows that the electrons were captured by Tm IV ions which must have been initially on cubic sites. Tm III ions were also observed after irradiation at room temperature with ionizing radiations and do not begin to decay rapidly until heated to about 550°C. The g value of Yb IV was measured at the X and K bands in the cubic field of CaF_2, and it was found that $g = 3.443 \pm 0.002$. The ground configuration of Tm III and Yb IV consists of a single hole in a full 4f shell and only two terms ${}^2F_{5/2}$ and ${}^2F_{7/2}$ occur, with the latter lower. Discussion is given on the significance of the results. (P.C.H.)

2332 CHARGE EXCHANGE BETWEEN KRYPTON IONS AND ATOMS. S. B. Karmohopatro (Saha Inst. of Nuclear Phys., Calcutta). J. Chem. Phys., 35: 1524-5 (Oct. 1961).

The cross sections of the reaction $Kr^+ + Kr \rightarrow Kr + Kr^+$ were measured in the energy range 3 to 7 kev. The apparatus used in the experiment is basically a mass spectrometer and a collision chamber. The cross section (Q) for the process $Kr^+ + Kr \rightarrow Kr + Kr^+$ in units cm^{-1} is calculated from the expression $Q = [I_x]/[pl][I_x + I_c]$, where l = length of the surface on which charge exchange ions are collected, and p = pressure in mm Hg. The indication of a minimum near ~5.5 kv shows that the reaction has a positive value of ΔE, the difference between the total energy of the initial and the final states. Data are presented in graphical form. (P.C.H.)

2333 THE EMISSION SPECTRA OF MIXED SULFIDES OF ZINC AND CADMIUM ACTIVATED WITH SILVER: EXISTENCE OF TWO EMISSION BANDS. Hugues Payen de la Garanderie (Faculté des Sciences, Paris). J. phys. radium, 22: 428-34(July 1961). (In French)

Two principal emission bands are observed in the spectra of the Cu- and Au- activated zinc and cadmium sulfides. The same is true for CdS(Ag). But ZnS(Ag) appears as an exception. The present work gives evidence for the occurrence of both bands in ZnS(Ag) also, supporting previous indications by Henderson and co-workers. The displacement of these bands has been studied in the mixed crystals ZnCdS(Ag), leading to their accurate identification. (auth)

2334 RESONANT SCATTERING OF PHOTONS IN Mg AND Si. Masumi Sugawara (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1857-65(Oct. 1961). (In English)

An NaI(Tl) scintillation spectrometer was used to study the resonant scattering of photons generated by the bremsstrahlung x rays. The resonant levels were found at 10.2 and 9.3 Mev in Mg and at 11.3 Mev in Si. Their level widths were obtained by the self absorption method. They are 3.8 and 0.9 ev in Mg, and 8.3 ev in Si, respectively. The spins and parities of these levels were assigned to be 1^+ by considering the isotopic spin multiplets. (auth)

2335 SAMPLE SANDWICHED PLASTIC SCINTILLATORS FOR ACTIVATION MEASUREMENTS BY USE OF FAST NEUTRONS. Masakatsu Sakisaka (Kōnan Univ., Kōbe, Japan), Bunzaburō Saeki, Michio Tomita, and Fumio Fukuzawa. J. Phys. Soc. Japan, 16: 1869-74(Oct. 1961). (In English)

Plastic scintillator plates sandwiched between thin radioactive samples were viewed with two photomultipliers and the coincident outputs were measured. For β^- rays, the pulse-height distributions showed approximately triangular shapes and the pulse-height endpoints were proportional to their maximum energies. Similar characteristics were also found in the case of γ rays. The counting efficiencies were empirically determined as functions of radiation energies in both cases. The sandwich scintillators having aluminum, copper, or silver foils as samples were exposed to 14-Mev neutrons and the induced activities of the samples only were counted effectively. Thus the Al^{27}(n,p), Cu^{63} · (n,2n), and Ag^{107}(n,2n) reaction cross sections were obtained with small standard deviations. (auth)

2336 THE SHIELDING OF A FIXED CHARGE IN A METAL. Shozo Shinohara (Hokkaido Univ., Sapporo). J. Phys. Soc. Japan, 16: 1963-9(Oct. 1961). (In English)

The shielding of a fixed charge of an impurity atom in a metal is calculated self-consistently by means of the first order perturbation theory without use of Poisson's equation. The displaced charge density of conduction electrons is finite at the center of the fixed charge, and the dependence of the exchange potential upon the wave vector results in a uniformly displaced charge density in the crystal. The theory is extended to the case of the degenerate electron gas including two static charges. (auth)

2337 SELF-ABSORPTION OF SPECTRAL LINE. Toshiharu Tako (National Research Lab. of Metrology, Tokyo). J. Phys. Soc. Japan, 16: 2016-32(Oct. 1961). (In English)

The line shape, line width, and other properties of self-absorbed line are discussed by introducing models on the spatial distributions of the emitting and absorbing atoms. The simple models in which the emitting atoms decrease linearly from the center to the outside proves to be sufficient to explain the general views on the self-absorption. The shapes of the visible triplet lines emitted by Hg^{198} and Cd^{114} lamps are observed without being disturbed by hyperfine structure of isotopes using a direct recording Fabry-Perot interferometer. From these observations, the effect of self-absorption of these lines is made clear and is shown to agree well with the results theoretically obtained. It is found that Hg^{198} and Cd^{114} lamps can be approximately represented by the model in which the emitting atoms decrease linearly from the maximum at the center to zero at the wall. The values of absorption parameter evaluated are able to be explained consistently, taking the population and decay time of the triplet states and their quenching due to collisions with carrier gas and electrons into consideration. (auth)

2338 STRUCTURE AND PROPERTIES OF A-CENTERS IN KCl. Kazuko Kojima (Osaka Women's Univ.), Noriko Nishimaki, and Tadanobu Kojima. J. Phys. Soc. Japan, 16: 2033-44(Oct. 1961). (In English)

In additively colored KCl crystals containing sodium, irradiation in the F-band causes its complete conversion in two absorption bands which are termed A$_1$ and A$_2$. By investigating their thermal, photochemical, and dichroic properties, these two bands are found to arise from a common species of centers called A-centers, and are identified with Petroff's A- and B-bands which have been found in nominally pure specimens. From the analysis of dichroic spectra, peak energy and half-width are determined for each band at several temperatures. The observed oscillator strength is 0.90 for the A$_1$-band and 0.81 for the A$_2$-band. The A-centers are destroyed thermally with an activation energy 0.43 ev. A model is proposed for the A-center that it consists of an F-center having a sodium ion as a nearest neighbor to the vacancy. A calculation of energy levels by the method of molecular orbitals is presented. (auth)

2339 NUCLEAR MAGNETIC RESONANCE OF Fe^{57} IN FINE POWDERED IRON. Shizuko Ogawa and Setsu Morimoto (Ochanomizu Univ., Tokyo). J. Phys. Soc. Japan, 16: 2065-6(Oct. 1961). (In English)

Observation of nuclear magnetic resonance in natural iron was made, using a frequency modulated marginal oscillator and a recording system which reproduces the second derivative of the resonance line. Particles with diameters of less than 1 μ exhibited a weak signal intensity. The effects of line width to strain and to particle size were measured, and the degree of oxidation and impurity content were examined. X-ray investigation of annealed samples showed no observable broadening other than that caused from the geometrical arrangement. (L.N.N.)

2340 HIGH-PRESSURE HYDROGEN GAS TARGET. J. Kirk (Univ. of Glasgow). J. Sci. Instr., 38: 439-41 (Nov. 1961).

A hydrogen gas target is described, which is designed to operate at 450 lb/in.^{2} and –70°C, to be used in studies of x-ray scattering from hydrogen using a nuclear photograph emulsion technique. The choice of material for the entrance window and the high-pressure sealing of flanges is discussed. (auth)

2341 PROBLEMS OF NUCLEAR PHYSICS AND SOME LARGER APPARATUS OF THE INSTITUTE OF NUCLEAR RESEARCH. Josef Habanec, Stanislav Safrata, František Nový, Pavel Franc, and Jan Němec (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Rez.). Jaderná energie, 7: 330-7(1961). (In Czech.)

Studies of nuclear reactions (reaction mechanism, the construction of a fission product magnetic analyzer, p–γ correlation measurement, nuclear polarization, and oriented nuclei measurement) are summarized. Research equipment, such as the cyclotron which accelerates deuterium ions to 13 Mev or alpha particles to 26 Mev and a small electrostatic accelerator of 1 Mev which affords the experience needed for the construction of the 4 to 5 Mev accelerator, is described. A brief outline is also given of the low temperature laboratory equipment (hydrogen and helium liquefier of GS-2 type and nitrogen liquefier of ZAK-80 type). (N.W.R.)

2342 STARK BROADENING OF THE SPECTRUM LINE 4603 Å. OF LITHIUM. K. C. Lapworth (National Physical Lab., Teddington, Middx., Eng.). Nature, 192: 252-3(Oct. 21, 1961).

The lithium line at 4603 Å arises from a 2p-4d transition. Under the action of a uniform electric field this line is displaced to longer wave-lengths and two other lines appear, one due to a 2p-4p transition and the other to a 2p-4f transition. The 2p-4p transition gives a weak line at 4636 Å for vanishingly weak electric fields, shifting to longer wave-lengths at increasing field strengths. The 2p-4f transition gives a line at 4602 Å for vanishingly weak fields, shifting to shorter wave-lengths at increasing field strengths. In the actual experiment the shock wave Mach number was 9.2, and the initial pressure of the argon 5 mm mercury. This gives a temperature of 11500°K and ion density of 1.6 × 10^{17} per cc behind the shock wave reflected from the end of the tube. (P.C.H.)

2343 ADVANCES IN THE GENERATION AND USE OF VERY HIGH, CONTINUOUS MAGNETIC FIELDS. Henry H. Kolm (Massachusetts Inst. of Tech., Cambridge). Nature, 192: 299-302(Oct. 28, 1961).

The four effects exerted by a magnetic field, which make it useful as a research environment, are discussed and evaluated. The production of laboratory magnetic fields along with some history of the production is also discussed. In an effort to advance the art of generating very high continuous fields, the Lincoln Laboratory Solid State Division at MIT launched a three effort program: first, the problem of designing high-performance solenoids was reexamined; secondly, a proposal was made that a new laboratory be built for the purpose of making generally available for research the highest continuous magnetic fields that can be generated at the present state of the art; thirdly, communication was established among scientists concerned with the generation and use of such fields. The progress made along these lines during the first three years is reported. (P.C.H.)

2344 ROTATIONAL ANALYSIS OF $^{65}Cu^{35}Cl$ BANDS. R. K. Asundi (Atomic Energy Establishment, Trombay, India), P. Ramakoteswara Rao, and J. K. Brody. Nature, 192: 444-5(Nov. 4, 1961).

Milligram quantities of $Cu^{62}Cl_2^{35}$ were prepared, and the spectrum of $Cu^{65}Cl^{35}$ was excited in an electrodeless discharge tube by a 2450 mc/sec. The rotational analysis indicates that the upper states of the five systems are either $^1\pi$, or $^1\Sigma$. This is apparently due to the circumstance that whereas there is no perturbing state near the F level, the levels D and B have each a perturbing state nearby. (P.C.H.)

2345 ELECTRON PARAMAGNETIC RESONANCE AND ANTIFERROMAGNETISM IN $LaCrO_3$. I. Weinberg and P. Larssen (Ford Motor Co., Newport Beach, Calif.). Nature, 192: 445-6(Nov. 4, 1961).

The experimental resonance investigations were carried out at 200 to 450°K. The powder was prepared by heating reagent grade Cr_2O_3 and La_2O_3 at 1600°C for 2 hr. The x-ray-diffraction results indicate a typical perovskite with small distortions from cubic symmetry. Assuming a cubic structure, the lattice parameter was found to be 3.870 Å. (P.C.H.)

2346 THE ELIMINATION OF FLUX PERTURBATION ASSOCIATED WITH NEUTRON DETECTING FOILS. J. D. Randall and J. V. Walker (Agricultural and Mechanical Coll., College Station, Tex.). Nuclear Sci. and Eng., 11: 69-73(Sept. 1961).

A $P_0^{\pm}$ calculation indicates that neutron detecting foils will cause no flux perturbation when prepared with a moderating ratio equal to that of the medium in which they are to be used. Such foils can be easily prepared from an appropriate solvent and solute. The activity in these foils can be conveniently determined on an absolute basis using liquid scintillation counting techniques, thus yielding an accurate value of absolute neutron flux. Measurements in polyethylene are reported. (auth)

2347 FIELD METRICS. III. FIELD CHARGES. P. Sen (National Physical Lab., New Dehli, India). Nuovo cimento (10), 21: 710-15(Sept. 1, 1961). (In English)

The determinants of the field metrics defined earlier by means of a correlation to the field wave equations are evaluated and found to be products of the strengths of the field charges. It is now suggested that these determinants have the value unity in the natural field units and the resulting correlations with principles of the theory of relativity are mentioned. It is shown that then, generally the strengths of all field charges can be determined. The procedure is illustrated in detail for the Tanikawa field theory and the obtained values of the field charges are found to support it. (auth)

2348 COLOR CENTERS IN THE ALKALI METAL AZIDES. H. A. Papazian (Convair Scientific Research Lab., San Diego, Calif.). Phys. and Chem. Solids, 21: 81-6 (Oct. 1961). (In English)

A study was made of the spectral bands in NaN_3, KN_3, RbN_3, and CsN_3 produced by UV irradiation. The ultraviolet, visible, and infrared regions were studied. A very strong correlation was found between the behavior of the bands produced in the visible and infrared. A new model based upon a charge-transfer complex was proposed for the F band. (auth)

2349 SPACE CHARGE EFFECTS IN AMBIPOLAR DIFFUSION OF CARRIERS INDUCED BY ELECTRON BOMBARDMENT IN PHOTOCONDUCTING INSULATOR CRYSTALS. Gy. Gergely (Research Inst. for Telecommunications, Budapest). Phys. and Chem Solids, 21: 105-9 (Oct. 1961). (In English)

An analysis is given of the ambipolar diffusion of carriers induced by electron bombardment. Induced conductivity and cathodoluminescence in ZnS and CdS crystals are discussed. The distribution of carriers is calculated, considering diffusion, surface recombination, and space charge effects. The effective ambipolar diffusion length is a result of negative space charge accumulated in traps, attracting holes and retarding electrons, preventing them reaching traps located deeper in the bulk and balancing the diffusion current. The negative space charge layer has to be compensated by a positive layer. Formulas are derived for linear and saturating type induced processes. Comparing the theoretical and experimental voltage response curves of cathodoluminescence and induced conductivity, the diffusion length L_p and surface recombination velocity S of holes can be determined. $L_p = 0.1\ \mu$, $S = 4 \times 10^4$ cm sec^{-1}, were found on a ZnS–AgCl sample. (auth)

2350 SOLIDIFICATION OF HELIUM AT 77°K. D. W. J. Langer (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Phys. and Chem. Solids, 21: 122-3 (Oct. 1961). (In English)

A phase change of He^4 was observed to occur at 77.3°K at 14140 bars. The maximal temperature deviation is estimated to be between 77.0 and 78.2°K. The maximal error in the determination of pressure is estimated to be ±1.4% (or ±200 bars). The phase change was observed by the piston displacement method and is evidently the transition between the gaseous and the solid phase. It is in good agreement with the extrapolation from experimental values and with predicted sublimation curves. (P.C.H.)

2351 ON THE BEHAVIOUR OF ELECTROLUMINESCENT PHOSPHORS ON IRRADIATION WITH ULTRAVIOLET. D. W. G. Ballentyne (Univ. of Hull, Eng.). Phys. and Chem. Solids, 21: 131-3(Oct. 1961). (In English)

During an investigation of the relation between electroluminescence and infrared emission, it was observed that the ultraviolet irradiation of an electroluminescent phosphor caused enhancement of the visible emission. By means of filters, it was shown that this emission and the enhanced emission was in the green. This effect may be alternatively explained by the assumption that the holes take some part in the processes of electroluminescence. Discussion is given on the mechanism of electroluminescence. (P.C.H.)

2352 DRAG FORCES IN ROTATING He II. Paul P. Craig (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 7: 331-4(Nov. 1, 1961).

The velocity field was studied in a rotating system using a type of detector which measures the drag forces exerted on disks placed normal to the stream lines of rotating helium II. Measurements of the temperature dependence of the drag force were made. Variation of the drag force with rotational velocity was plotted. Two distinct types of behavior were found. Agreement with the Rayleigh disk experiment (NSA, 15: 13537) was obtained. (L.N.N.)

2353 OSCILLATORY GALVANOMAGNETIC EFFECT IN METALLIC SODIUM. R. Bowers, C. Legendy, and F. Rose (Cornell Univ. Ithaca, N. Y.). Phys. Rev. Letters, 7: 339-41(Nov. 1, 1961).

Observations in sodium of very high conductivity ($\rho_{300°K}/\rho_{4°K} \approx 7500$; $\omega_c\tau \approx 40$ in 10^4 gauss) were made. It was found that the Lorentz force produced an electrical oscillation of 5 to 35 cycles/sec. Direct evidence of a particular macroscopic electron gas excitation described by P. Aigrain (*Proceedings of the International Conference on Semiconductor Physics, Prague, 1960*, 224(1961)) and named "helicon" excitation was found. (L.N.N.)

2354 NUCLEAR SPIN STATES IN MOLECULAR CRYSTALS. L. B. Borst, S. L. Borst, L. Koysooko, H. Patel, and E. Stusnick (New York Univ., New York). Phys. Rev. Letters, 7: 343-5(Nov. 1, 1961).

Neutron beam attenuation by a sample immersed in liquid helium was measured. Temperatures below 4°K were achieved by evacuating the liquid helium and reducing the boiling point. The neutron beam was derived from a reentrant hole in an aqueous moderator immersed in liquid helium. A velocity spectrum of the emergent beam was best fitted by a Maxwell distribution having a temperature of 40°K. Time-dependent cross sections of acetylene and spectral distributions from aqueous moderators at 4°K were measured and the results are graphically represented. Nuclear spin states found in water and acetylene are expected in many molecular crystals, the rotational energy levels being shifted to higher temperatures by the crystal potential. (L.N.N.)

2355 EXPERIMENTS ON LAMINAR AND TURBULENT FLOW OF He II IN WIDE CAPILLARIES. F. A. Staas, K. W. Taconis, and W. M. Van Alphen (Kamerlingh Onnes Laboratorium, Leiden). Physica, 27: 893-923(Oct. 1961). (In English)

Laminar and turbulent flow of pure He^4 through wide capillaries of circular cross section, respectively 82, 174, and 255 μ in diameter, were studied in the He II region above 1°K. The viscosity of the normal fluid was derived from the laminar flow behavior using a special technique. It was found that the Reynolds number $Re = d\rho v_n/\eta_n$, containing the total density ρ, the normal fluid velocity v_n, the viscosity η_n, and the diameter of the capillary d, is a parameter characterising the flow in the whole velocity range. One of the fundamental equations of motion in the high velocity range appeared to be the Navier Stokes equation containing the total density, the normal fluid velocity, and the viscosity of the normal fluid. The dependence of the pressure gradient on the normal fluid velocity is then represented by an equation analogous to the classical empirical formula for turbulent flow of ordinary fluids as given by Blasius. It was found that within the experimental accuracy direction and magnitude of the superfluid velocity did not affect the pressure gradient. In connection with the phenomena of turbulence, the various results on gravitational flow are discussed. Finally an experiment on turbulent flow of He^3-He^4 mixtures in the He II region, using a capillary 156 μ in diameter, is communicated. (auth)

2356 SUPERFLUID FLOW IN WIDE CAPILLARIES. F. A. Staas and K. W. Taconis (Kamerlingh Onnes Laboratorium, Leiden). Physica, 27: 924-9(Oct. 1961). (In English)

A method is described to detect the phenomenon of mutual friction in a superfluid flow with the normal fluid at rest. The results show that the mutual friction varies with a third power of the superfluid velocity. The critical velocities of onset of mutual friction are measured as a function of the temperature. (auth)

2357 ON THE GENERALIZED BOLTZMANN EQUATION OF A QUANTUM GAS. E. Fujita (Université, Brussels). Physica, 27: 940-56(Oct. 1961). (In English)

The generalized master equation for a quantum gas due to Résibois is analyzed with the aid of new diagrams, which are intimately related to operator diagrams invented by Prigogine and Résibois. It is shown that part of this equation, which is important for the derivation of generalized Boltzmann equation, has a form analogous to the Pauli equation with the probability of quantum statistical transition between many-body states, the probability being expressible in terms of a matrix A formally identical to the so-called transition matrix defined in the modern theory of potential scattering. By use of the technique devised for developing the binary collision expansion of the quantum statistical pair propagator, many-body elements of A are expanded in terms of two-body elements of A. The generalized Boltzmann equation or the reduced equation for the average occupation number of a single-particle momentum state is derived in an usual manner from the generalized master equation. It is pointed out that the Uehling-Uhlenbeck equation for a hard-sphere Fermi gas is valid only in the lowest order a^2, a being diameter of a hard sphere, at the very low temperatures. The new equation valid up to the order $a^2(ap_F h^{-1})$, p_F being the Fermi momentum of an ideal Fermi gas and h Planck's constant, is given explicitely. Any higher order corrections could easily be calculated in the frame work of the theory. (auth)

2358 ON THE QUANTUM STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. PART [II.] J. Vlieger, P. Mazur, and S. R. De Groot (Universiteit, Leiden). Physica, 27: 957-73(Oct. 1961). (In English)

The quantum statistical theory of Wigner distribution functions, presented previously on the foundations of non-equilibrium thermodynamics, is used to develop the theory of joint Wigner distribution functions, which may be employed for the calculation of quantum mechanical correlation functions. The joint equilibrium distribution function of a set of extensive state variables is defined. This distribution function is expressed in terms of the joint Wigner distribution function of the micro-canonical ensemble. The properties of joint equilibrium distribution functions of extensive variables, in particular the so-called property of detailed balance, are studied. It is shown that joint equilibrium distribution functions are joint probabilities, if the set of quantum mechanical operators, corresponding to the extensive variables, is of a certain class. The theory of distribution functions of extensive state variables thus obtained, which is formally the same as developed previously on the basis of classical statistical mechanics, is used for the derivation of the Onsager reciprocal relations in non-equilibrium thermodynamics. The theory is developed for Maxwell-Boltzmann statistics. (auth)

2359 ON THE QUANTUM STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. [PART] III. J. Vlieger, P. Mazur, and S. R. De Groot (Universiteit, Leiden). Physica, 27: 974-8(Oct. 1961). (In English)

The quantum statistical theory of Wigner distribution functions, developed previously on the foundations of non-equilibrium thermodynamics for Maxwell-Boltzmann statistics, is extended to the cases of Bose-Einstein and Fermi-Dirac statistics. (auth)

2360 FIELD EFFECTS ON PHOTOCONDUCTIVITY QUENCHING. G. Diemer (Philips Research Labs., Eindhoven, Netherlands). Physica, 27: 979-8(Oct. 1961). (In English)

The influence which the applied field exerts on the amount of photoconductivity quenching by I.R. in cadmium sulfide crystals is explained. Kitamura, Kubo, and Yamashita found that with increasing strength of the applied electric field the quenching by I.R. changes to a stimulation, and from this they conclude that the common interpretation (quenching is due to an enhanced recombination caused by the liberation of charge carriers from activator levels) cannot be correct. Other experiments indicated that, depending on the temperature of the crystal, an increase of the field can either increase or decrease the amount of I.R. quenching. It is shown that the Klasens-Schon model can explain the field enhancement and field quenching. The measurements of Kitamura, Kubo, and Yamashita are explained by this model. (N.W.R.)

2361 RE-IGNITION OF HIGH CURRENT SPARK DISCHARGES. R. J. Churchill (Univ. of Liverpool). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 3: 291-2(Oct. 1961). (In English)

Recovery characteristics of high current spark discharges are obtained for 235 ka discharges between electrodes of various sizes and materials (copper and tungsten) in air at atmospheric pressure. A comparison of re-ignition voltage characteristics for hydrogen, air, and argon is also obtained for 235 ka discharges between tungsten rod electrodes. The circuit of the high current genertor and restriking voltage generator is shown. Two trends are observed in the recovering spark channel: a rapid initial recovery up to about 2 msec and a slower rate thereafter as the re-ignition voltage approaches the sparking gap potential. For most characteristics the fully-recovered time is about 20 msec, and in all cases investigated is less than 100 msec. The best reproducibility of results is found for hydrogen. The re-ignition characteristics show that electrode size has a considerable influence upon the overall gap recovery. In this study, re-ignition measurements are made only during the spark breakdown period. (N.W.R.)

2362 FORMULAE FOR NON-DEGENERATE RAYLEIGH-SCHRÖDINGER PERTURBATION THEORY IN ANY ORDER. R. Huby (Univ. of Liverpool). Proc. Phys. Soc. (London), 78: 529-36(Oct. 1, 1961).

It is shown that Bloch's solution for the *n*th order perturbation of the energy and the eigenvector in the Rayleigh-Schrödinger perturbation theory of non-degenerate, discrete levels can be expressed in a different form, of a kind suggested by Brueckner, and some advantages of the latter form are presented. (auth)

2363 PARTIAL WAVE THEORY OF POSITRON-HYDROGEN ATOM COLLISIONS. K. Smith (Argonne National Lab., Ill.). Proc. Phys. Soc. (London), 78: 549-53 (Oct. 1, 1961).

Derivation of radial equations for positron–hydrogen atom collisions from the continuous state Hartree-Fock equations is presented. Angular coefficients are expressed in terms of vector addition coefficients and Racah coefficients for any angular momentum state of the atomic systems: positronium and atomic hydrogen. Boundary conditions are written in terms of the S-matrix and expressions are obtained for total and differential cross sections. (auth)

2364 ELECTRICAL BREAKDOWN OF GASES: IONIZATION GROWTH IN AIR AT HIGH PRESSURES. J. Dutton, F. Llewellyn Jones, and R. W. Palmer (Univ. Coll. of Swansea, Wales). Proc. Phys. Soc. (London), 78: 569-83 (Oct. 1, 1961).

Experimental conditions necessary to measure ionization coefficients accurately at high values of pressure times gap distance (pd) are assessed. Precision measurements were carried out for uniform electric fields in air for pd up to 2300 mm Hg cm. Pre-breakdown ionization growth in air, due to primary and secondary ionization processes modified by the process of attachment, was discovered. Significant space charge effects were absent. At 2300 mm Hg cm, the sparking potential calculated (81 ± 1.5 kev) from the criterion agreed well with that observed. The state of the cathode surface had a marked influence on secondary ionization at these values of pd. For $35 \le E/p \le 40$ vcm^{-1} (mm Hg)$^{-1}$ and pressures at 400 to 1000 mm Hg, the apparent secondary ionization coefficient was found to be a function of E/p alone, whereas the primary coefficient showed a small decrease with increasing pressure. (L.N.N.)

2365 ON RESONANT CHARGE TRANSFER IN IONIZED DENSE GASES. Iovitzu Popescu (Physics Inst. of the RPR Academy, Bucharest). Proc. Phys. Soc. (London), 78: 584-7(Oct. 1, 1961).

When a feebly ionized gas is compressed until the mean distance between atoms decreases down to approximately less than ten times an atomic radius, the positive charge is not carried by the ion in motion but rather jumps resonantly from atom to atom. This is deduced by comparing the mean time of flight of the positive ion between two collisions with the resonant transfer time of the electron from the atom to the next positive ion. (auth)

2366 MEASUREMENTS OF ROTATIONAL ENERGY DISTRIBUTIONS IN IONIC COLLISIONS. E. M. Reeves and R. W. Nicholls (Univ. of Western Ontario, London, Can.). Proc. Phys. Soc. (London), 78: 588-93(Oct. 1, 1961).

The measured rotational intensity distribution of N_2^+ First Negative bands excited by 1-Mev protons indicates that the rotation of the molecules is not greatly affected by the collisions. Measured rotational temperatures compare favorably with laboratory temperatures. Similar observations on N_2^+ bands excited by 1 to 3 kev Li^+ ions show that these collisions appear to cause a marked departure from Boltzmann distribution of rotational energies. Energy levels of high and of low quantum numbers are enhanced in population. (auth)

2367 LOW-TEMPERATURE TRANSPORT PROPERTIES OF THE ALKALI METALS. II. THE TRANSPORT COEFFICIENTS. J. G. Collins and J. M. Ziman (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A264: 60-87(Oct. 24, 1961).

A previous theory is applied to the direct calculation of the "ideal" electrical and thermal resistivities and "phonon drag" thermoelectric power of the alkali metals. All 3 coefficients depend, in magnitude and as functions of temperature, on the Fermi surface shape and on the lattice spectrum. If it is assumed that the latter is identical in form for all the metals in the group, the observed transport coefficients are consistent with a Fermi surface which is distorted in lithium, becomes nearly spherical in sodium and potassium, and is again distorted in rubidium and cesium. The argument is not sufficiently accurate to discriminate between *s*-like and *p*-like symmetry in each case, nor to decide whether the Fermi surface actually touches the zone boundary; the phonon drag effect is also very sensitive to the purity of the specimen. (auth)

2368 ELECTRON CAPTURE IN FAST COLLISIONS. I. CAPTURE BY FAST PROTONS IN ATOMIC HYDROGEN. M. R. C. McDowell (Royal Holloway Coll., [London]). Proc. Roy. Soc. (London), A264: 277-88(Nov. 7, 1961).

Formal perturbation theory is employed to obtain the matrix element for electron capture by fast particles of mass M_B and charge Z_B from atoms of mass M_A and charge Z_A, allowing for the internuclear potential and distortion by the incoming particle. Explicit formulae are presented for the 1s–1s transition. Detailed calculations were carried out for protons in atomic hydrogen. For this case, distortion significantly reduces the cross-section at proton energies below 100 kev, but at higher energies its effects and those of the internuclear potential largely cancel each other. (auth)

2369 PROPAGATION OF SHOCK WAVES IN INHOMOGENEOUS MEDIUM. IV. SECOND ORDER APPROXIMATION. Noboru Ohyama (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 251-62(Aug. 1961). (In English)

A first order approximation formula for the propagation of shock waves in inhomogeneous medium was presented by extending Chisnell's method. Corrections to the formula are obtained taking into account effects of second-order reflected waves. The calculation is restricted to the case of strong shock limit and it is shown that the rate of growth of the shock strength obtained by the first approximation is little influenced, so far as the strong shock limit is concerned, by taking the effects of the second-order waves into consideration. (auth)

2370 LITHIUM LOADED LIQUID SCINTILLATOR. J. Hejowowski (Medical Academy, Lodz, Poland) and A. Szymanski. Rev. Sci. Instr., 32: 1057-8(Sept. 1961).

Lithium-loaded liquid scintillators are discussed in relation to the problems encountered in the detection of thermal neutrons. Lithium propionate is the salt used in the scintillators. The percentage (wt) of lithium propionate that will dissolve in various compositions of toluene-methyl alcohol is graphically shown. The relative light output, for the various compositions, measured with gamma rays, is also graphically shown. This light output is given relative to the light output of toluene + (4g/liter p-terphenyl + 0.01 g/liter POPOP) + methyl alcohol + lithium propionate taken as 1. One percent of lithium propionate gives about 7×10^{19} atoms Li/cm^3, which corresponds to a macroscopic cross section of 5×10^{-3} cm^2. This value can be increased by utilizing lithium enriched in lithium-6. The relatively low content of lithium is the main drawback of this scintillator. (N.W.R.)

2371 TO THE QUESTION ABOUT DISPERSION OF LONGITUDINAL AND TRANSVERSAL WAVES IN THE RELAXATIVE LIQUIDS. A. S. Predvoditelev. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 10-18(May-June 1961). (In Russian)

The equations for longitudinal and transverse wave oscillations were derived on the basis of Maxwell fluid motion. Dispersion formulas based on identical and kinematic Hadamard conditions are derived for transverse acoustic oscillations in a relaxing medium. (R.V.J.)

2372 THE DISCHARGE AT POINT—PLATE GAPS IN EXTREMELY PURE RARE GASES AND THEIR MIXTURES AS WELL AS WITH ADDITIONS OF ELECTRONEGATIVE GASES. Manmatha Kumar Das (Lichttechnisches Institut, Karlsruhe, Ger.). Z. angew Phys., 13: 410-15(Sept. 1961). (In German)

The object of the present work is the investigation of the corona discharges in very pure neon, argon, and their mixtures and in rare gases with determined additions of electronegative gases such as carbon dioxide, oxygen, and nitrogen. The studies were made both with positive and negative points at various pressures. Additional measurements were made in pure carbon dioxide, oxygen, and nitrogen. (tr-auth)

2373 DECAY OF NEGATIVE MUONS IN THE K SHELL. L. Krueger and J. Rothleitner (Universität, Heidelberg, Ger.). Z. Physik, 164: 330-40(1961). (In German)

The decay rate of bound muons from the K-shell and the spectrum of the decay electrons are calculated for seven elements up to lead. The muon is represented by a nonrelativistic wave function in the potential of a realistic nuclear charge distribution. The electron wave function is expanded in partial waves which allows taking into account exactly the relativistic and the finite nuclear size effects. The decay rate decreases monotonically but slowly with increasing atomic number. This agrees with earlier theoretical predictions but contradicts most of the experimental results for medium as well as high atomic number. (auth)

2374 ON SOME SPECIAL COORDINATE SYSTEMS IN GENERAL SPACE-TIME. J. L. Synge. p.15-28 of "The Golden Jubilee Commemoration Volume (1958-1959) Calcutta Mathematical Society." (In English)

Space-time with coordinates x^i, a symmetric covariant fundamental tensor g_{ij}, and a symmetric contravariant fundamental tensor g^{ij}, satisfying $g^{ij}g_{kj} = \delta^i_k$, is considered. The field equations of general relativity subject the ten components of g_{ij} and such other unknowns as occur to certain partial differential equations. When properly formulated, the number of unknowns exceeds the number of equations by four, thus the necessity for four additional equations arises, these equations being identified as "coordinate conditions" and serving to identify the coordinate system employed. If the coordinate conditions specify four of the ten components of g_{ij}, the original field equations become determinate. Gaussian coordinates are the simplest to use. (L.N.N.)

2375 DISPERSION RELATIONS AND CAUSAL DESCRIPTION. AN INTRODUCTION TO DISPERSION RELATIONS IN FIELD THEORY. Jan Hilgevoord. Amsterdam, North-Holland Publishing Company, 1960. 144p.

The meaning of "causality" is introduced using as an example, the scattering of light. The well-known propagators of the unquantized wave equation solution are discussed, and the relation between causality conditions and dispersion relations, which is purely mathematical, is explained. Dispersion relations for the unquantized wave equation scattering amplitude are derived, and the formulation of the causality condition in terms of wave packets is compared with a formulation starting from the field propagator. An account is given of the derivation of dispersion relations from the basic postulates of relativistic quantum field theory. (L.N.N.)

2376 LA THÉORIE DES GAS NEUTRES ET IONISÉS. (Theory of Neutral and Ionized Gases). C. De Witt and J. F. Detoeuf, eds. Paris, Hermann and New York, John Wiley & Sons Inc., 1960. 469p.

The chapters are divided into nine sections; separate abstracts have been prepared for each. Six of the nine sections are in English; the remaining three are in French. (P.C.H.)

2377 TOPICS ON STATISTICAL MECHANICS OF INTERACTING PARTICLES. Elliot W. Montroll (Univ. of Maryland, College Park). p.15-148 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

Statistical mechanics was developed to show how the macroscopic behavior of materials is connected with the properties of atoms and molecules (and various elementary particles such as electrons) and the laws of interaction between them. Gibbs philosophy is discussed, and modern diagram and operator techniques are appended. A systematic procedure for investigating the required cluster integrals is outlined, and some comments are made on the cluster integrals of assemblies of particles with hard core repulsion. Some discussion is also given on transport theory. The theory of random walks in discrete spaces is presented, and the theory of the liquid-gas phase transition in a fluid is given to show that certain continuum problems can be discussed through periodic lattice models. Ninety references are given. (P.C.H.)

2378 LECTURES ON STATISTICAL MECHANICS OF NONEQUILIBRIUM PHENOMENA. Léon Van Hove (Instituut voor Theoretische Fysica, Utrecht). p.149-83 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

Discussion is given on the equations by which the time evolution of many particle systems toward equilibrium may be described, and how they behave under the influence of external forces or constraints preventing equilibrium. The physical systems consist of electrons and heavy particles or neutral or ionized atoms, and discussion is concentrated on electrical conductivity. Over-all electrical neutrality is assumed. A new derivation of the Pauli equation is given, based on the weak coupling or low density assumption, and the random phase assumption at the initial time t_0. (P.C.H.)

2379 MICROSCOPIC THEORY OF IONIZED GASES. Jean-Loup Delcroix (Laboratoire des Hautes Energies, Orsay, France). p.185-249 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In French)

Discussion is given on the functions of simple and multiple distributions, which includes definitions and non-correlation between particles; anisotropies and moments of simple distribution, which includes the development of a simple distribution function in a series of spherical functions, and relations between the anisotropies and the macroscopic moments; equations of microscopic evolution; correlations in a plasma, including elementary theory and correlations in thermodynamic equilibrium; and gyromagnetic and Bremsstrahlung radiation of plasmas. (P.C.H.)

2380 HYDROMAGNETICS AND THE THEORY OF PLASMA IN A STRONG MAGNETIC FIELD, AND THE ENERGY PRINCIPLES FOR EQUILIBRIUM AND FOR STABILITY. Martin Kruskal (Princeton Univ., N. J.). p.251-74 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

A table is given which shows the interrelation of hydromagnetism and the theory of plasma in a strong magnetic field. In connection with the table, the following topics are discussed: basic equations, properties of static equilibrium, energy variational principle for static equilibrium, energy variational principle for stability, and types of instability, which includes Rayleigh-Taylor, Helmoltz, interchange, and stellarator instabilities. (P.C.H.)

2381 ASYMPTOTIC THEORY OF SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS WITH ALL SOLUTIONS NEARLY PERIODIC. Martin Kruskal (Princeton Univ., N. J.). p.275-64 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

Using a system of ordinary differential equations, discussion is given on how to find a mathematical representation of any solution of $X' = f(X)$ which will be valid, not just in a finite range of s, during which the orbit of the solution drifts in X-space only by an amount of order ϵ from its initial loop, but for a range of s of order $1/\epsilon$, during which the drift is finite. Particular attention is paid to Hamiltonian systems and their possession of adiabatic invariants to all orders. (P.C.H.)

2382 LANDAU DAMPING. Martin Kruskal (Princeton Univ., N. J.). p.285-92 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

The phenomenon of a damped electric field, Landau damping, is discussed along with the theory of singular normal modes, the paradox they constitute, and the exact nonlinear wave solutions which partly resolve the paradox. (P.C.H.)

2383 PLASMA TRANSPORT THEORY. Allan N. Kaufman (Univ. of California, Livermore). p.293-353 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In English)

The Fokker-Planck equation, describing the time-development of the Boltzmann distribution function $f^a(r, v, t)$, is used as the basic equation to derive the transport coefficients of a full ionized plasma. The plasma consists of electrons and protons (or deuterons) only. The Fokker-Planck equation is then used to describe the two components of the plasma. The longitudinal effect in an electric field is also discussed. (P.C.H.)

2384 STUDY OF THE ELECTROMAGNETIC WAVES IN PLASMA BEGINNING WITH THE BOLTZMANN EQUATION. Jean-François Denisse (Observatorie de Paris, Meudon, France). p.355-74 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In French)

Discussion is given on Landau absorption (longitudinal component), cyclotron absorption (transversal component), determination of the dispersion equation by Laplace transformation, and longitudinal oscillations in the presence of a magnetic field. (P.C.H.)

2385 THE PLASMA IN ASTROPHYSICS. Evry Schatzman (Institut d'Astrophysique, Paris). p.375-469 of "La Théorie des Gaz Neutres et Ionisés." Paris, Hermann and New York, John Wiley & Sons Inc., 1960. (In French)

Discussion is given on variations in the local thermodynamic equilibrium, which includes elementary processes in ionized gases, thermodynamics of irreversible processes, number of recombinations by triple collisions, number of radiative recombinations, mechanism of equilibrium temperature, temperature of the electrons, and equilibrium in low and high temperatures; radiation of a plasma, including thermal, Cherenkov, and synchrotron, and observations of radio radiations, and radiosources; interstellar magnetic field; and the magnetics of the sun and the stars. (P.C.H.)

Astrophysics and Cosmology

2386 (AFOSR-1401) THE INTERSTELLAR ABUNDANCE OF THE HYDROGEN MOLECULE. Robert J. Gould (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). Aug. 31, 1961. Contract AF49(638)-915. 44p.

The various processes which determine the concentration of molecular hydrogen in H I clouds are investigated. It is shown that, contrary to the results of previous investigations, the processes involving a dissociation of the molecule are quite negligible compared to the relatively rapid formation of H_2 on the surfaces of grains. As a result there is a gradual buildup of molecular hydrogen in the clouds until the clouds, through their random motion, pass near a bright star whereby the H_2 is dissociated again. The percentage of hydrogen which should have associated to molecular form is estimated under various conditions. In particular, calculations are made for the case of a constant ratio of gas to dust density and for the case where the dust density is independent of the gas. The results vary considerably, depending on the conditions but the general results point to the likelihood of a molecular hydrogen concentration comparable to that of the observed atomic hydrogen and in some circumstances to a value much greater than that of the atomic concentration. (auth)

2387 (ML-837) ON THE THERMAL GENERATION OF TOROIDAL MAGNETIC FIELDS IN ROTATING STARS. L. Mestel and I. W. Roxburgh (Stanford Univ., Calif. Microwave Lab.). Aug. 1961. Contract AF49(638)-342. 29p. (AFOSR-1386)

It has been shown that in a rotating star without any initial magnetic field, the electron partial pressure slowly generates a toroidal magnetic field of considerable strength. The problem is reconsidered assuming the star to have a primeval magnetic field with its poloidal component much weaker than the toroidal field predicted formerly. It is shown that the magnetic torque and the rotation field is sufficient to ensure that the electron pressure has negligible effect, whether or not there is meridian circulation of matter inside the star. (J.R.D.)

2388 ABUNDANCES OF HEAVY NUCLIDES. Donald D. Clayton and William A. Fowler (California Inst. of Tech., Pasadena). Ann. Phys. (N. Y.), 16: 51-68(Oct. 1961).

A table is presented giving calculated contributions to abundances of the heavy elements ($A \geq 63$) from the two major mechanisms of heavy element stellar nucleosynthesis, the r- and s-processes. Isotopes of the elements are tabulated individually because of variation among isotopes of relative importance of the two mechanisms. The table facilitates comparison between prediction based on stellar nucleosynthesis and observed nuclidic abundances. (auth)

2389 INTENSITY INCREASE OF DIFFERENT COMPONENTS OF COSMIC RADIATION PRIOR TO THE MAGNETIC STORM OF MAY 11, 1959. B. Trumpy and T. Svanes. Årbok Univ. Bergen, Mat.-Naturv, Ser., No. 8, 14p. (1961). (In English)

The cosmic storm connected with the magnetic storm of May 11, 1959 is investigated on the basis of recordings from a great number of stations spread over the globe. At several of these stations an increase of the radiation intensity is observed preceding the sudden commencement of the magnetic storm. Studies of this increase effect, and its dependence on the longitude and latitude of the stations are given. The additional radiation preceding the commencement of the magnetic storm has a distinct anisotropy in that it is found only at the daylight face of the earth. The anisotropy of this augmentation-effect is also shown by directional measurements of the hard component of cosmic rays at the Norwegian stations Bergen and Tromsø. The results support the assumption that the increase effect is due to a reflection of cosmic particles from the approaching face of the magnetized solar stream. (auth)

2390 SOLAR-PRODUCED COSMIC RAYS FOLLOWING THE SOLAR FLARES OF NOVEMBER 12 AND 15, 1960. B. Trumpy and T. Svanes (Univ. of Bergen). Årbok Univ. Bergen, Mat.-Naturv. Ser., No. 14, 14p. (1961). (In English)

Measurements of cosmic radiation during and after solar flare periods on November 12 and 15, 1960, performed in Bergen, Norway, are presented. Altogether 10 different components are studied: the neutron component, the total radiation, the soft component, and several hard components incident from different directions. In the neutron component large increases of 90% and 84% are observed on November 12 and 15, the first one having a doublet structure. A corresponding increase of the other cosmic ray components is not observed, showing that the solar-produced cosmic radiation has a low energy spectrum. On November 12 at about 18:30 U.T. a Forbush-decrease occurs in these soft and hard cosmic ray components. The expiration of this Forbush-decrease is described, and its connection with the simultaneous variations of the neutron component is discussed. On the basis of experimental material from several other recording stations an approximate integral energy spectrum is found for the solar produced radiation responsible for the different maxima of the intensity curves for the neutron component. A small intensity increase in all the recorded components on November 13 at about 9:30 U.T.—prior to a strong Forbush-decrease—is probably caused by a reflection of cosmic ray particles from the approaching face of magnetized solar plasma. (auth)

2391 SOLAR PROTONS FROM THE FLARE OF JULY 10, 1959. R. R. Brown and R. G. D'Arcy (Univ. of California, Berkeley). Arkiv Geofysik, 3: 443-7(1961). (In English)

From a series of balloon flights launched from College, Alaska in July 1959, observations of the radiation from the solar flare of July 10, 1959 were obtained. The proton component of the radiation, largely responsible for the polar cap absorption at that time, had a steep energy spectrum. In addition, it was accompanied by a strong gamma ray component, penetrating deep into the atmosphere. Possible origins of the gamma radiation are discussed. (auth)

Cosmic Radiation

Refer also to abstract 1980

2392 (INSJ-42) OBSERVATIONS ON HIGH ENERGY JETS AND GAMMA-RAYS WITH LARGE EMULSION CHAMBER. M. Akashi, K. Shimizu, Z. Watanabe, T. Ogata, N. Ogita, A. Misaki, I. Mito, S. Oyama, S. Tokunaga, M. Tamura, Y. Fujimoto, S. Hasegawa, J. Nishimura, and K. Yokoi (Tokyo Univ. Inst. for Nuclear Study). Oct. 3, 1961. 20p.

Large emulsion chambers of several square meters were constructed and exposed to cosmic rays to study the high energy jets and the gamma spectra. About 1000 gamma rays with energy higher than 10^{12} ev were observed, and the spectrum showed the gradual increase of the exponent with increasing energy. Direct observations were also made for the high energy jets extending up to approximately 10^{15} ev, and the spectrum of π^0 mesons produced in an individual event showed some systematic change with increasing primary energy. The relation between these observed spectra and the interpretation of these phenomena are discussed. (auth)

2393 COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. PART II. THE CORRELATION WITH SOLAR RADIO BURSTS. F. Bachelet, P. Balata, A. M. Conforto, and G. Marini (Università, Rome; Istituto Nazionale di Fisica Nucleare, Rome; and Commissione Italiana Anno Geofisico Internazionale, Rome). Nuovo cimento (10), 21: 648-58(Aug. 16, 1961). (In English)

A statistical approach is discussed to the comparison of the time correlation of solar radio bursts of spectral types II and IV with the geomagnetic and cosmic ray storms. The analysis is carried out for the events of the period July 1957 to July 1958. The solar radio bursts best correlated to the geophysical perturbations under study turn out to be type IV radio events, although the correlation is far from being of the one to one character. The comparison with other results makes it clear that a better definition of type IV emission is fundamental in this respect. (auth)

2394 HYDROGEN NUCLEI OF THE PRIMARY COSMIC RADIATION. C. J. Waddington (Univ. of Bristol, Eng.). Phil. Mag. (8), 6: 965-70(Aug. 1961).

A small stack of nuclear emulsions was used to determine the flux of cosmic ray protons over Texas. The experimental procedure was similar to that used previously, but due to the more favorable conditions of the exposure the dependence of the value at the top of the atmosphere on the, rather uncertain, corrections for the overlying matter, was greatly reduced, the correction being 0.902 c.f., the previous 0.694. The value found for the flux at the top of the atmosphere on July 12, 1960, was 540 ± 50 protons/m^2ster sec. (auth)

2395 MEASUREMENTS OF THE MOMENTUM SPECTRUM AND CHARGE RATIO OF COSMIC RAY MUONS AT SEA LEVEL IN THE MOMENTUM RANGE 10 GEV/c–1000 GEV/c. J. E. R. Holmes, B. G. Owen, and A. L. Rodgers (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 78: 505-15(Oct. 1, 1961).

The momentum spectrum of single cosmic ray muons arriving at sea level in the north–south plane at 57°N geomagnetic latitude was measured for near vertical incidence. Results are given which cover the momentum range $5 < p < 1000$ Bev/c, and together with the earlier work of Owen and Wilson form a continuous spectrum from 0.5 to 1000 Bev/c. The high momentum work is based on 1800 particles of momentum greater than 10 Bev/c. The charge ratio of single muons arriving at sea level was measured, for near vertical incidence, to an upper momentum limit of 100 Bev/c. The measurements are compared with those of other workers and together show evidence for a maximum in the sea level charge ratio in the momentum range 3 to 7 Bev/c. (auth)

2396 ZENITH ANGLE DISTRIBUTION OF EXTENSIVE AIR SHOWERS AT 8500m ABOVE SEA LEVEL. Koichi Kamata (Cosmic-Ray Lab., [Tokyo]). Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 130-7(Sept. 1961). (In English)

The zenith angles of the incident direction of air showers with particle density larger than $20m^{-2}$ are observed at an altitude of 8500m. The measurement of the incident angle of each shower particle is made by the Fukui-Miyamoto discharge chamber (F.M. chamber), which is triggered by the coincidence pulse of scintillation counters. The whole experimental apparatus is mounted in the cabin of a DC-8 jet airplane. A total of 162 pictures of the F.M. chamber obtained during the flight experiment are analyzed, and the zenith angle distribution is obtained. The result shows that an intensity maximum exists at an angle of about 45° from the zenith. This result is in good agreement with the distribution expected from the altitude variation, and indicates that the intensity maximum of air showers, whose particle density is, on the average, several tens of particles per square meter, lies at an atmospheric depth of about 520 $g.cm^{-2}$. (auth)

Criticality Studies

Refer also to abstract 2701

2397 (ANL-6336) CRITICAL STUDIES OF A 450-LITER URANIUM OXIDE FAST REACTOR CORE (ZPR-III ASSEMBLY 29). A. L. Hess, W. Gemmell, J. K. Long, and R. L. McVean (Argonne National Lab., Ill.). Nov. 1960. Contract W-31-109-eng-38. 46p.

Results of studies with ZPR-III Assembly 29, a mockup of a typical, dilute UO_2-fueled fast reactor, are reported. The assembly consisted of a 454-liter cylindrical core, blanketed with depleted uranium, with a critical mass of 421 kg U^{235}. Experiments included measurements of fission rates, material reactivity worths, and Rossi alpha. The results of multigroup calculations using the present Argonne cross section sets are presented, and discrepancies between experimental results and calculations are discussed. (auth)

2398 (APAE-54(Suppl.1)) EXTENDED SM-2 CRITICAL EXPERIMENTS CE-2. W. J. McCool, R. A. Robinson, S. H. Weiss, T. M. Raby, E. W. Schrader, and L. D. Walthousen (Alco Products, Inc., Schenectady, N. Y.). June 30, 1961. Contract AT(30-3)-326. 153p.

A description and results of a second series of critical experiments performed on the SM-2 core mockup are presented. The SM-2 core mockup contains 36.4 kg of U^{235} and an estimated 67.9 g of B^{10}. The equivalent diameter and the active height are about 22 in. The metal-to-water volume ratio is 0.344. Data are presented on activation, reactivity, and stuck rod measurements. All measurements were conducted on the open 7 control rod array employing 38 stationary fuel elements. Activation measurements consisted of neutron flux measurements using uranium fission foils for relative power distribution studies, the effect of flux suppressors on reducing power peaks, blocked coolant channel measurements, and gamma dose distribution. Reactivity measurements were performed to determine the effect of flow divider, flux suppressors, and simulated high temperature and pressure operation, B^{10} loading in the SM-2 core, and core material coefficients. For the latter, the worth in cents per gram or cents per cm^3 was determined at a simulated temperature of 510°F for B^{10}, U^{235}, stainless steel, and void. Stuck rod measurements were made to obtain an indication of the criticality margin in the event one or more control rods should stick in the operating position. (auth)

2399 (DP-643) EXPONENTIAL VOID COEFFICIENT MEASUREMENTS FOR NATURAL URANIUM TUBES IN D_2O. Warren B. Rogers, Jr. (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 23p.

Exponential experiments and theoretical calculations were performed to determine the reactivity effect of expelling D_2O coolant from D_2O-moderated lattices of natural uranium fuel assemblies composed of coaxial metal tubes. Both the exponential experiments and the calculations confirmed independent critical measurements in showing large increases (up to 4%) in K_∞ when water is expelled from the coolant channels. (auth)

2400 (GA-2313) REACTIVITY OSCILLATION MEASUREMENTS OF THE THORIUM DOPPLER COEFFICIENT IN THE HTGR CRITICAL FACILITY. J. R. Brown and J. B. Sampson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). July 1, 1961. Contract AT(04-3)-314. 46p.

The Doppler coefficient, $(1/I)(dI/dT)$, was measured for several HTGR fuel elements in the HTGR critical assembly at temperatures up to 650°K by a reactivity oscillation technique. The correction required because of a small effect upon neutron temperature caused by heating the central fuel element (the thermal base effect) was also determined experimentally. The coefficient, $(1/I)(dI/dT)$, is about 3.5×10^{-4}/°C at 300 to 650°K. It increases slightly with thorium loading. (auth)

2401 (KAPL-M-GHM-6) DESCRIPTION AND ANALYSIS OF SOME "OVER-MODERATED" CRITICAL EXPERIMENTS FROM 68–550°F. G. H. Miley and R. D. Gillespie (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1961. Contract W-31-109-Eng-52. 87p.

Over-moderated light water-Zircaloy-U^{235} critical assemblies were studied where in some instances the same core was clean critical at two different temperatures. These results provided an accurate check of analytic techniques as a function of temperature. Data are presented for 9 20-24 in. × 24 in. × 30 in. cores with a U^{235} density of 0.022 g/cm^3 and meta/water ratios from 0.42 to 0.83. Calculated $K_{eff's}$ temperature coefficients, and power distributions generally showed reasonable agreement with experiment, but some discrepancies were noted. (auth)

2402 (KAPL-M-GHM-7) DESCRIPTION AND ANALYSIS OF SOME RELATIVELY LARGE, LOW $\beta\gamma$ CRITICAL EXPERIMENTS WITH SEMI-DISTRIBUTED BORON STRIPS FROM 68-550°F. G. H. Miley and B. Miller (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1961. Contract W-31-109-Eng-52. 68p.

Critical experiments from 68 to 550°F are described involving 24 in. by 24 in. by 30 in. light water moderated and reflected, enriched uranium–Zircaloy cores with a metal-water ratio of 0.5. The cores were characterized by "semi-distributed" poison boron-steel plates adjacent to every second or third fuel plates. The very complex power distribution perturbations thus produced were analyzed with good accuracy using two different techniques which are modifications of conventional analytic methods. Reactivity and temperature results based on these techniques showed fair agreement with experiment. (auth)

2403 (USASRDL-TR-2185) IRRADIATION OF SEMIRAD AT GODIVA II (AUGUST 27-28, 1959). Harry M. Murphy, Jr. (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Feb. 15, 1961. 49p.

Experiments performed on Godiva II with the use of the SEMIRAD systems are described. The experiments were concerned mainly with the problem as to how close the recorded Godiva pulse agrees with the actual burst. For this purpose, the SEMIRAD results were compared with readings from a parallel-plate ion chamber and from fluor dose-rate meters. A theoretical comparison was made of the Godiva pulse with experimental data. The influence of the burst on coaxial lines used to transmit the SEMIRAD signal was also investigated. The results affirmed the ability of SEMIRAD to follow the Godiva II gamma pulse at the closest possible distances. (auth)

2404 (AEC-tr-4715) CRITICAL MASSES OF URANIUM–GRAPHITE REACTORS. A translation of "Kriticheskie Massy Uran-Grafitovykh Reaktorov." G. I. Marchuk, G. A. Ilyasova, V. E. Kolesov, V. P. Kochergin, L. I. Kuznetsova, and E. I. Pogudalina (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 18p.

A method was developed for the calculation of critical masses of reactors with thermal, intermediate, and fast neutrons. The calculation was based on the diffusion approximation. The many-group system of reactor equations was setup with allowance for both elastic and inelastic scattering of neutrons by moderator nuclei in the region of epithermal energies. In the thermal group, allowance was made for the thermalization of neutrons. Results of calculations of critical masses of uranium–graphite reactors are given as functions of enrichment with U^{235}. (auth)

2405 CRITICALITY OF LOW ENRICHMENT U^{235} IN HYDROGEN. John Mihalczo (Oak Ridge National Lab., Tenn.) and C. B. Mills. Nuclear Sci. and Eng., 11: 95-6 (Sept. 1961).

Six experiments were performed on the uranium density in paraffin and water at 0.5 to 3.1 gm/cm^3. The H : U^{235} atomic ratios varied from 200 to 1000. Calculations were performed, using two methods (NSA, 15: 15077). Results, represented tabularly and graphically, gave $k_{eff} = 1.00 \pm 0.01$. Critical radii of unreflected spheres were calculated, and effects of an infinite paraffin reflector on the 2% enrichment calculations are given. (L.N.N.)

Elementary Particles and Radiations

2406 (AFOSR-1534) A VARIATIONAL SOLUTION FOR THE SCATTERING OF ELECTROMAGNETIC PULSES FROM A CYLINDER OF FINITE LENGTH. Institute of Engineering Research Series No. 60, Issue No. 392. W. J. Welch (California. Univ., Berkeley. Electronics Research Lab.). Aug. 11, 1961. Contract AF49(638)-1043. 30p.

The problem of the scattering of an essentially plane electromagnetic pulse by a thin metallic cylinder of finite length is treated by means of a variational formula. The pulse is a delta function, and it is assumed that the current induced on the scatterer is a damped sinusoid with the frequency of oscillation such that the cylinder is one half wavelength long and the damping is due to radiation. The characteristic damping is calculated by a related variational technique. The time dependence of the echo at a large distance from the cylinder is plotted for two different thicknesses of the cylinder. (auth)

2407 (JINR-D-743) ELASTIC SCATTERING OF 2.8 AND 6.8 Bev/c NEGATIVE PIONS ON CARBON. B. P. Bannik, A. M. Galper, V. G. Grishin, L. P. Kotenko, L. A. Kuzin, E. P. Kuznetsov (Kuznetzov), G. I. Merson, M. I. Podgoretskii (Podgoretzki), and L. V. Silvestrov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 20p.

Elastic scattering of 2.8- and 6.8-Bev/c negative pions on carbon nuclei has been studied. The differential cross sections obtained are analyzed with the aid of the optical model. It has been shown that the characteristics of elastic negative pion scattering on carbon depend only upon the transferred momentum. The cross section for negative pion scattering on a neutron to the backward half-sphere has been estimated as $\sigma_{\pi n} (\geq 90°) \leq 0.4$ mb, (2.8 Bev/c) and $\sigma_{\pi n} (\geq 90°) \leq 0.1$ mb, (6.8 Bev/c). (auth)

2408 (JINR-D-773) BEHAVIOUR OF THE PION-PION ELASTIC SCATTERING AMPLITUDE AT HIGH ENERGIES (NEUTRAL MODEL). G. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 10p.

The imaginary part of the elastic scattering amplitude of neutral, pseudoscalar particles is calculated in the high-energy limit for small momentum transfer. The expression obtained leads to constant total cross section at infinite energy. The momentum-transfer distribution shows a forward diffraction peak. The form of the latter is independent of energy. (auth)

2409 (NP-10956) MESON DEUTERON INELASTIC SCATTERING. Erasmo M. Ferreira (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 49p. (Notas de Fisica, Vol. VIII No. 1).

The formal expression for the scattering operator for meson-deuteron inelastic scattering is expanded in terms of two-particle scattering operators. The terms of the expansion which represents first- and second-order processes are explicitly evaluated and discussed. The Coulomb interaction of two protons in the final state is treated. Formulae for the cross-sections for inelastic (without charge exchange) and charge-exchange meson-deuteron scattering are given. (auth)

2410 (NP-10992) ANGULAR DISTRIBUTION AND POLARIZATION OF Λ' S IN $\pi-p$ COLLISIONS. S. W. MacDowell, A. L. L. Videira, and N. Zagury (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 13p. (Notas de Fisica Vol. VII, No. 16, p.333-45)

The angular distribution and polarization of Λ's in $\pi-p$ collisions was studied assuming that all but the S-wave comes from the exchange of a K'-meson. The data were analyzed at energies of 960 and 1300 Mev of the incident pion. A satisfactory result was obtained for the higher energy and favored a vector K'-meson. In the region of 960 Mev the model appeared inadequate. (auth)

2411 (TID-14213) POLARIZATION OF $Li^7(p,n)Be^7$ NEUTRONS FOR 4 TO 10 MeV PROTONS. W. Benenson, T. H. May, and R. L. Walter (Wisconsin. Univ., Madison). [1960?]. Contract AT-11-1-GEN-7. 15p.

The polarization of $Li^7(p,n)Be^7$ neutrons was measured at nine proton energies between 4 and 10 Mev. The dependence of the polarization on reaction angle was determined at 4.0, 4.7, 5.9, 6.9, 7.9, 9.1, and 10.0 Mev. The polarizations were deduced from the asymmetry of n-He^4 scattering. Neutrons which left Be^7 in its ground state and first excited state were detected with approximately equal efficiency and were not resolved from each other. (auth)

2412 (AEC-tr-4141(p.101-3)) DISCOVERY OF THE ANTINEUTRON. K. Bobińska. Translated from Nukleonika, 2: No. 2, 347-9(1957).

The discovery of antiprotons and antineutrons is discussed. The experiment used at Berkeley in discovery of the antineutron is described. The existence of the antineutron was confirmed by the emission of a large amount of energy in the annihilation process during collision of the antineutron with a neutron of matter. (M.C.G.)

2413 (JPRS-10727) MULTIPLE GENERATION OF PARTICLES IN NUCLEON-NUCLEON AND π-MESON-NUCLEON COLLISIONS IN THE REGION OF ACCELERATOR ENERGIES. Oleg Czyzewski and Roman Holynski. Translated from Postepy Fiz., 12: No. 1, 71-87(1961). 27p.

A review is presented of studies conducted at Brookhaven and Dubna concerning the multiple production of particles in N-N and π-N collisions in the regions of the accelerator energies. Characteristics common to the interactions at 5 to 10 Bev are summarized. The results of the studies were compared to statistical and theoretical concepts for explaining the interactions. The contributions of these studies toward furnishing information concerning the structure of the nucleon is discussed. (B.O.G.)

2414 (UCRL-Trans-726) ATTEMPT AT A THEORY OF THE BETA RAYS. [PART] I. E. Fermi. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Z. Physik, 88: 161-77(1934). 36p. (Includes original, 17p.).

A quantitative theory of beta disintegration is suggested in which the existence of the neutrino is assumed and the emission of the electrons and neutrinos from a nucleus during the beta disintegration is treated in a similar way as the emission of a light quantum from an excited atom in radiation theory. Formulas for the life and for the form of the emitted continuous beta spectra are derived and compared with experimental findings. (auth)

2415 PROBLEMS OF THE POLARIZATION OF FAST NEUTRONS. I. Mînzatu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz Studii cercetări fiz., 12: No. 1, 185-201(1961). (In Rumanian)

A particle system is oriented if the spins of the particles are parallel or antiparallel with a fixed direction in space; in the case of parallelism in a preferred direction, the system is considered completely polarized. In general there is no direct correlation between the the spin of nucleons of a beam and an arbitrary axis. The following methods may be used for creating a beam of polarized nucleons: applying an intense external field, nuclear reactions especially those involving oriented nuclei and coupling of the spin of the nucleon with its orbital moment by nuclear diffusion. The polarization appearing as the result of spin-orbit coupling is of special interest because it involves nuclear forces, thus giving information about the structure of the nucleus. The theoretical aspects of this problem are discussed. (24 references). (TTT)

2416 ANGULAR AND ENERGY DISPERSION OF π^--MESONS IN THE DISPERSED MAGNETIC FIELD OF THE 6-METER SYNCHROTRON. V. G. Kirillov-Ugryumov, A. A. Kropin, V. S. Roganov, and A. V. Samoilov. Atomnaya Energ., 11: 245-6(Sept. 1961). (In Russian)

To make effective use of the charged-particle beams of accelerators, their behavior during passage through the dispersed field of the electromagnet must be known. The data may be computed from the known configuration of the magnetic field. Calculations of this type were carried out concerning the movement of π^--mesons formed on the internal target of the 6-m synchrotron of the Joint Institute for Nuclear Research (at Dubna), using formulas which define the horizontal and the vertical motion of charged particles in a symmetrical azimuthal field. Analysis of the data obtained indicate that π^--mesons having energies higher than 100 Mev are de-focussed if the divergence of the beam increases by a factor of about 3. Doubled horizontal and vertical focussing is noted at meson energies less than 100 Mev. Decreasing the distance from the target to the center of the magnet enhances the focusing action of the accelerator. (TTT)

2417 ON THE WAVE FUNCTION OF THE ANOMALOUS STATE OF FERMI-SYSTEM. Z. Galasiewicz (Univ. of Wrocław, Poland and Inst. of Physics, Polish Academy of Sciences, Wrocław, Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 9: 605-7(1961). (In English)

The ground state and excited states of the anomalous state are considered, and the wave functions are derived. (L.N.N.)

2418 ANGULAR DISTRIBUTIONS OF FAST NEUTRONS ELASTICALLY SCATTERED ON Ca. K. Małuzyńska, L. Natanson, J. Turkiewicz, and P. Żupránski (Univ. of Łodź, Poland and Inst. for Nuclear Research, Polish Academy of Sciences, [Łodź], Poland). Bull. acad. polan. sci., Sér. sci., math., astron. et phys., 9: 621-3(1961). (In English)

Results concerning elastic scattering were obtained using neutrons having a continuous energy spectrum. Angular distributions of neutrons elastically scattered on Ca were measured for energies above 1 Mev. This limit was due to a high background below 1 Mev; the upper limit was determined by the decrease of the neutron energy. (L.N.N.)

2419 A PHENOMENOLOGICAL MODEL FOR HIGH-ENERGY INTERACTIONS. II. THE ENERGY SPECTRUM OF THE SECONDARIES. Benjamin Reuter and Kurt Sitte

(Israel Inst. of Tech., Haifa). Bull Research Council Israel, Sect. F, 10: No. 1, 3-16(Aug. 1961). (In English)

Consequences of the demand that mesons of energy ϵ cannot be localized within $R < hc/\epsilon$ are developed. For high-energy nucleon-nucleon interactions, this means that separation of the particles will precede secondary emission, and a two-particle model must be applied. Moreover, it is shown that at every stage of the expanding cloud, only particles of a given energy can escape. The energy spectrum of the secondaries is therefore uniquely determined by the rate of expansion of the cloud. This process can be described from general principles of thermodynamics and dynamics only. The resulting energy spectrum resembles a power law with a slope ~ -1.8 to -1.5, and a pronounced high-energy tail. For sufficiently large inelasticities ($\gtrsim 0.2$ for $\gamma_L = 10^2$, and $\gtrsim 0.05$ for $\gamma_L = 10^5$), some high energy secondaries may also be emitted before separation of the nucleons. Their contribution varies from ~10% for k = 0.1, to about 20 to 30% for k = 0.3. The energy spectrum in the center-of-mass system is flatter than in N, its steepness depending on the inelasticity of the process. The average secondary energy increases slowly with the primary energy. (auth)

2420 PARTICLES IN A NON-STATIONARY SCALAR FIELD. P. Burcev (Univ. of Brno). Československ. časopis pro fysiku, A 11: 371-5(1961). (In Czech.)

Classical relativistic equations of motion are applied for particles in two types of nonstationary scalar fields. A description is given of the process of the emission of particles with zero rest mass and the carrying of a particle through a field with the velocity of light. (auth)

2421 BINDING ENERGY OF Λ^0 PARTICLE IN LIGHT HYPERFRAGMENTS. Jitka Polanska and Zdenek Turzik (Inst. of Technology and Nuclear Physics, Prague). Československ. časopis pro fysiku, A 11: 386-9(1961). (In Czech.)

The binding energy of a Λ^0 particle in eight mesonic decays of hyperfragments was measured. The hyperfragments were chosen from K^- meson interactions with emulsion nuclei. Comparison of the measured values with those previously obtained is given. (auth)

2422 QUANTIZATION IN PENTADIMENSIONAL THEORY (LINEAR APPROXIMSTION). Sylvie Lederer. Compt. rend., 253: 386-8(July 17, 1961). (In French)

By quantizing in five-dimensional Euclidean space the field introduced by the pentadimensional representation of a particle with maximum spin 2, one quantizes in fact the Jordan-Thiry unitary field with linear approximation, independently of the parameter which figures in the expression of the first. (tr-auth)

2423 POLARIZATION IN PAIR PRODUCTION CONSIDERING THE EFFECTS OF FINITE NUCLEAR DIMENSIONS. B. K. Kerimov and F. S. Sadykhov (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 14-19(1961). (In Russian)

The effect of finite nuclear dimensions on the angular distribution of longitudinally polarized electron-positron pairs formed by circularly polarized γ quanta in a nuclear field was investigated. The derived cross section formula contains spin correlation terms, considering mean square radius of the nuclear charge, in addition to the Bethe-Gaitler cross sections. (R.V.J.)

2424 ON THE THEORY OF POLARIZED PARTICLES WITH SPIN ONE. Yu. A. Popov and Yu. M. Loskutin (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 20-7(1961). (In Russian)

The boson wave equations are expressed by the Schröedinger equation, the spin operators are found, and the second equation for the wave function is determined. The boson wave functions, considering polarization, were derived, and the polarization vector and its transformation properties were determined. (tr-auth)

2425 ON INTERACTIONS OF SLOW PARTICLES. V. D. Kamenetskii (All-Union Correspondence Inst. of Textile and Light Industry, USSR). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz. No. 3, 42-9(1961). (In Russian)

An approximation method is suggested for calculating interactions of slow particles. The method is coupled to variation methods based on the Hulthen-Cohn function. The invariant ratios and their mathematical expressions are derived. The results of calculations for electron scattering in an exponential field and on hydrogen atoms are correlated with various approximation methods. The method produced sufficiently accurate data. (tr-auth)

2426 EFFECTS OF ANTIPROTON BEAM REFRACTION IN NUCLEI ON ABSORPTION SPECTRA. Yu. D. Fiverskii (Moscow Inst. of Engineering Physics). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 76-9(1961). (In Russian)

The refraction of a long wave, $\lambda \ll R$, antiproton beam in nuclear matter (R is the nuclear radius) was investigated. Antiproton reactions with nuclei were analyzed by the optical model. The cross section of antiproton absorption was found in optical geometry terms. It is shown that antiproton beam refraction causes only a slight increase of the absorption spectra. (R.V.J.)

2427 ON QUANTUM THEORY OF NON-LINEAR MESON FIELDS. D. Ivanenko and D. Kurdgelaidze (Moscow State Univ.). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 109-21(1961). (In Russian)

The problem of determining the permutation function in nonlinear field theory is analyzed. It is shown that ordinary means must be abandoned, and it is suggested that the permutation function must be identified with a certain radially symmetric field equation solution. An approximation quantization is carried out for nonlinear neutral meson fields. (tr-auth)

2428 ON CLASSIFICATION OF TWO-COMPONENT FERMIOS AND THE ANALOGY BETWEEN WEAK AND ELECTROMAGNETIC INTERACTIONS. E. M. Lipmanov (Serafimovic Stalingrad Pedagogical Inst., USSR). Izvest. Vysshikh Ucheb. Zavedeniĭ, Fiz., No. 3, 140-6(1961). (In Russian)

It is postulated that the properties of bare fermions in decay reactions can be determined by classification of zero-mass fermions, using the possible values of electron, baryon, or lepton charges and integral magnitudes of the γ_5 operator. The Hamiltonian for decay interactions is constructed using an analogy with the electrodynamics in the relation of isotopic vector and isotopic scalar currents. The experimental verification of the scheme was performed by analyzing nucleon emission asymmetries and longitudinal polarizations in hyperon-lepton decay. (tr-auth)

2429 THE INVARIANCE GROUP ASSOCIATED WITH RELATIVISTIC ROTATORS AND THE BILOCAL THEORY. F. Halbwachs (Institut Henri-Poincaré, Paris), J. M. Souriau, and J. P. Vigier. J. phys. radium, 22: 393-406 (July 1961). (In French)

Three noteworthy results are established: First, it is shown in the frame of a very general treatment, that the set of fundamental constants of the motion which can be derived from each invariance group of a given line-Lagrangian gives rise to classical Poisson Brackets which fulfill relations identical to the Lie algebraic relations of the group. Secondly, any particle endowed with internal variables can be represented by a "bilocal" rotator composed of two relativistic tetrads localized at two different points. Finally, the usual one-parameter and two-parameter gauge transformations in spinor form can be translated into tetrad form with an obvious kinematical interpretation. (auth)

2430 INTERNAL MOVEMENTS OF A RELATIVISTIC PARTICLE. M. Kleman (Institut Henri-Poincaré, Paris). J. phys. radium, 22: 435-42(July 1961). (In French)

A relativistic particle without external field, obeying the laws of conservation of linear momentum and angular momentum, is usually described by a skew tensor $\mathscr{M}_{\mu\nu}$, its covariant derivative $\dot{\mathscr{M}}_{\mu\nu}$ and a constant linear momentum p_μ. In order to materialize the physical fact of internal rotation, we introduce in the theory a second point particle without supplementary assumptions: the motion of a material point-particle can be described as the relative motion of two particles, relative motion which is summarized by a skew tensor $\omega_{\alpha\beta}$, of the same nature as the rotation pseudovector of a rigid body in classical mechanics. So one finds a formula relating the unitary velocities of the two point-particles, but $\omega_{\alpha\beta}$ depends still on 6 arbitrary parameters. By obvious physical considerations of reciprocity between these two point-particles (reciprocity of momenta and velocities), we can make these degrees of freedom disappear and the rotation reduce to a simple expression. We then restrict ourselves to the study of a particular class of motion for a relativistic particle, the idea of reciprocity being extended to point-particles themselves. If one point-particle is given, the second is consequently found, and reciprocally. So one generalizes the so-called Weyssenhoff's motion, in which the two reciprocal points have the same space-time coordinates. (auth)

2431 ISOTOPIC SPIN DEPENDENCE OF NUCLEON-NUCLEON CROSS-SECTIONS BETWEEN 600 AND 1000 Mev. G. Martelli, H. B. van der Raay, R. Rubinstein, K. R. Chapman, J. D. Dowell, W. R. Frisken. B. Musgrave, and D. H. Reading (The University, Birmingham, Eng.). Nuovo cimento (10), 21: 581-92(Aug. 16, 1961). (In English)

The ratio of the differential cross sections for p-p and p-n scattering at 90° in the cms are measured at three energies, between 600 and 1000 Mev, using fast scintillation counters in conjunction with magnetic momentum analysis. The value of this ratio decreases markedly with increasing energy, from 3.04 ± 0.56 at 595 Mev, to 1.00 ± 0.18 at 775 Mev, and to 0.683 ± 0.097 at 1010 Mev, showing an enhancement of the scattering amplitude in the T = 0 state above 600 Mev. It is shown how this behavior may be related to the second resonance in π-p scattering. (auth)

2432 SOME ANALYTIC PROPERTIES OF A DECAY AMPLITUDE WITH FINAL STATE INTERACTIONS. I. THE VERTEX DIAGRAMS IN $K \rightarrow 3\pi$ DECAY. G. Barton (Inst. for Advanced Study, Princeton, N. J.) and C. Kacser. Nuovo cimento (10), 21: 593-604(Aug. 16, 1961). (In English)

The simplest vertex-type diagrams for $K \rightarrow 3\pi$ decay contain an internal double pion line; when the total rest-mass parameter λ of this line is taken as discrete, the amplitude possesses on the physical sheet an anomalous branch point above the normal one, subject to the condition $(M^2 - \mu^2)/2 < \lambda^2 < (M - \mu)^2$, with M the kaon and μ the pion mass. On integrating over λ^2 this singularity is eliminated. In order to understand the amplitude fully, we must consider it temporarily as a function of two complex variables, in which a double dispersion representation is found to hold. The spectral functions are examined in semiclosed form to exemplify these statements, and to give a perturbation-theory illustration of some of the popular approximations in calculations on this decay. (auth)

2433 A NEW TECHNIQUE IN THE STATISTICAL MODEL OF PARTICLE PRODUCTION. T. Ericson (CERN, Geneva). Nuovo cimento (10), 21: 605-32(Aug. 16, 1961). (In English)

A new method is introduced to account for conservation laws in the statistical model of particle production. The approach becomes exact in the limit of high multiplicities; it leads to simple analytical expressions which allow immediate estimates of the influence of the various conservation laws under different circumstances. Momentum conservation is shown to have little influence on the energy spectra of the emitted particles; its consequences for the angular correlation of particles are studied. The statistical weight factors, which result from the coupling of the isospin vectors of the emitted particles with isospin conservation imposed, are shown to be well represented by semi-classical expressions; the dependence of the weight factors on total isospin and multiplicity becomes obvious. The general effects of angular momentum conservation in the statistical model are studied; the angular distributions are forward-backward symmetric in the cm system, a prediction specific to the model and a suitable test to its validity. In the classical approximation the angular distribution is forward-backward peaked, though not more than a limiting distribution $1/\sin \theta$, where θ is the angle of the particle with the beam direction. Angular momentum conservation leaves energy spectra nearly unchanged, while multiplicities are strongly affected by it; the effective interaction volumes in nucleon-antinucleon annihilation and nucleon-nucleon collisions are shown to be approximately the same, when this effect is taken into account. (auth)

2434 PHENOMENOLOGICAL ANALYSIS OF PHOTON-PROTON ELASTIC SCATTERING. K. Berkelman (Istituto Superiore di Sanità, Rome). Nuovo cimento (10), 21: 633-47(Aug. 16, 1961). (In English)

Recent experimental data on Compton scattering by the proton at energies above 300 Mev suggest an extension of previous phenomenological calculations. The present model takes into account the Thompson and magnetic moment scattering, the electric dipole scattering from the virtual charged pion current, and the low diagram dependent on the π^0 mean life. The resulting differential cross section is in qualitative agreement with the available data. The polarization of the recoil proton and the dependence on incident photon polarization are also calculated. Above 500 Mev the cross sections for unpolarized and polarized photons and the recoil proton polarization are all quite sensitive to the π^0 mean life. (auth)

2435 ON THE TRIPLE ANGULAR CORRELATION. V. De Sabbata (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 21: 659-70(Aug. 16, 1961). (In English)

A general formulation of triple angular correlations is given in order to examine the β-γ-γ correlation in particular and its implications on the symmetry properties of the weak and strong interactions. The invariance for time reversal is especially considered. (auth)

2436 THE LINEAR $K\pi$ INTERACTION AND THE RELATIVE Σ-Λ PARITY. S. Barshay (Brandeis Univ., Waltham, Mass.). Nuovo cimento (10), 21: 671-3(Aug. 16, 1961). (In English)

A phenomenological explanation of the marked forward peaking of K^0 in the process $\pi^- + p \rightarrow K^0 + \Lambda$ is presented. It is shown that the peaking can be answered under the hypothesis that the relative Σ-Λ parity is odd. From this discussion there is hope of reconciling the long-standing features of the phenomenological linear K-π interaction with both CP invariance and with the observed difference between Σ and Λ production at moderate energies, under the hypothesis of odd relative Σ-Λ parity. (N.W.R.)

2437 TWO-PION EXCHANGE CONTRIBUTION IN PROTON COMPTON SCATTERING. A. P. Contogouris (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10), 21: 674-8(Aug. 16, 1961). (In English)

The inclusion of two-pion exchange effects, with appropriate phase and strength, significantly improves the theoretical predictions in proton Compton scattering of relatively short range at low photon energies. Results (graphical) show that the differential cross sections for proton Compton scattering at θ_{cm} equal 90 and 135° are good up to 270 Mev, apart from the points at about 240 Mev, θ_{cm} equal 135° (N.W.R.)

2438 HYPERON PHOTON DECAY. G. Calucci and G. Furlan (Università, Trieste and Istituto Nazionale di Fisica Nucleare, Trieste). Nuovo cimento (10), 21: 679-83(Aug. 16, 1961). (In English)

A pole approximation is discussed in order to evaluate the decay rate and the other characteristic parameters of the process $Y \rightarrow N + \gamma$. (N.W.R.)

2439 SOME CONSEQUENCES OF NUCLEAR FORCES DUE TO PION-PION INTERACTION. Y. Fujii (Nihon Univ., Tokyo). Nuovo cimento (10), 21: 684-7(Aug. 16, 1961). (In English)

Preliminary information is given concerning the repulsive central potential in the ^3O-state, the strong repulsive tensor potential in the ^3E-state, and the L-S potential in the ^3E-state. In the case of the deuteron, the results suggest that the potentials due to the pion-pion resonance, though considerably strong, have only a small effect as far as the static properties of the deuteron are concerned. It is also shown that the strong repulsive L-S potential appearing in the ^3E-state may compensate the effect of the strong repulsive tensor potential, as far as the deuteron is concerned. (N.W.R.)

2440 STUDY AT 1.15 Bev/c OF ASSOCIATED PRODUCTION $\pi^+ + p \rightarrow \Sigma^+ + K^+$. A. Berthelot (Centre d'Etudes Nucleaires, Saclay, France), A. Daudin, O. Goussu, F. Grard, M.-A. Jabiol. F. Lévy, C. Lewin, A. Rogozinski, J. Laberrigue-Frolow, C. Ouannès, and L. Vigneron. Nuovo cimento (10), 21: 693-709(Sept. 1, 1961). (In French)

Seventy-eight associated production events $\pi^+ + p \rightarrow \Sigma^+ + K^+$ were investigated by means of a propane bubble chamber (40 × 20 × 20 cm) placed in a magnetic field of 12.7 k gauss. The beam used had a momentum of (1.155 ± 0.025) Bev/c, and had the following composition: $\pi^+ : p : \mu^+ : e^+ = 100 : 10 : 8 : 1$. The following results were obtained: the total ($\sigma = (0.214 \pm 0.025)$ mb) and differential cross sections obtained are in agreement with the charge independence hypothesis; for $\Sigma^+ \rightarrow \pi^+ + n$ events, no significant asymmetries, up-down, right-left, or forward-backward, were found; the mean life of Σ^+ is $\tau = (0.75^{+0.13}_{-0.09}) \cdot 10^{-10}$ sec. (auth)

2441 THE USE OF PROJECTION OPERATORS TO OBTAIN THE MATRIX ELEMENTS FOR PARTICLES OF SPIN ½. E. Bellomo (Università, Genoa). Nuovo cimento (10), 21: 730-9(Sept. 1, 1961). (In Italian)

For the purpose of writing down formulas for relativistic immediate computation of matrix elements between free states for a particle of spin ½, use of projection operators is made. Expressions are obtained allowing computation of matrix elements of any operator up to a phase. (auth)

2442 EMISSION OF FAST DEUTERONS AND TRITONS FROM K^--MESONS CAPTURED AT REST IN NUCLEAR EMULSION AND A SEARCH FOR THE HYPERNUCLEUS (Σ^-n). D. Evans (H. H. Wills Physics Lab., Bristol, Eng.), B. D. Jones, B. Sanjeevaiah, et al. Nuovo cimento (10), 21: 740-6(Sept. 1, 1961). (In English)

Results of mass measurements on fast baryons emitted in the capture at rest of 7600 K^- mesons are described. The analysis is restricted to those interactions from which neither charged π mesons, nor slow Σ hyperons (kinetic energy ≤ 69 Mev), nor hyperfragments are emitted. As already reported in a previous work, a substantial number of deuterons and tritons is present among the fast baryons: the proportion of deuterons of kinetic energy exceeding 84 Mev is (11.1 ± 2.5)%, that of tritons is (2.3 ± 1.0)%. Fast deuterons and tritons of ranges greater than 1 cm are emitted from at least (1 ± 0.2)% of K^- mesons interactions at rest in nuclear emulsion. Among the fast baryons a number of Σ hyperons decaying in flight were observed and measured: no (Σ^-n) hypernucleis were detected. (auth)

2443 ON THE GAUGE INVARIANT THEORY OF ELEMENTARY PARTICLE INTERACTIONS. P. Roman (Boston Univ.). Nuovo cimento (10), 21: 747-63(Sept. 1, 1961). (In English)

Weak interactions of elementary particles are derived from the principle of gage invariance, following the general framework of Sakurai's investigations (Sakurai, J. J., Ann. of Phys., 11: 1(1960)). It is found that only one new boson, an isospinor of the second kind, has to be introduced. The actual weak processes can be obtained by combining the basic V-A interaction, which automatically gives an explanation for the $|\Delta t| = ½$ and $|\Delta S| = 1$ rules, with strong interactions. A systematic study of the electromagnetic interaction is presented, indicating that, besides the photon field, the hypercharge—and the isospin—boson field also play a role, giving rise to short-range corrections for the familiar electromagnetic interaction. It is pointed out that the weak and electromagnetic interactions destroy the strict gage invariance of the second kind for bosons which transmit the strong interactions, and therefore make it possible for them to have a non-vanishing rest mass. Finally, the consequences of hypercharge and isospin assignments for leptons are investigated, and it is shown that such an assignment automatically leads to a "muon number" which is conserved in all interactions. (auth)

2444 METHOD OF APPROXIMATION FOR THE DETERMINATION OF SEMI-PHENOMENOLOGICAL NUCLEON-NUCLEON POTENTIALS. H. Cornille (Laboratorie Joliot-Curie de Physique Nucléaire, Orsay, France). Nuovo cimento (10), 21: 773-85(Sept. 1, 1961). (In French)

A formalism allowing connection of phenomenological parameters of different potentials in nucleon-nucleon scattering with experimental results is constructed. Phase-shifts and coupling parameters are obtained. It is shown that phase-shifts are obtained by numerical calculations of two integrals, the two integrals being solutions of Volterra's coupled integral equations whose kernels depend explicitly on potentials. (auth)

2445 THE DEFINITION OF ELECTROMAGNETIC RADIATION. F. Rohrlich (State Univ. of Iowa, Iowa City).

Nuovo cimento (10), 21: 811-22(Sept. 1, 1961). (In English)

Momentum and energy of electromagnetic radiation emitted from a charge are Lorentz-covariantly defined. In the non-local measurement of a Lorentz invariant, the rate of radiation energy emission is proposed as a necessary and sufficient criterion for the emission of radiation at a given time. This measurement is a field measurement which can be performed at any distance from the charge and need not be made in the wave zone. It can be regarded as an operational definition of radiation in terms of rate of energy emission. These results permit a simple derivation of the equation of motion of a charged particle which avoids the self-energy difficulties. A question concerning the principle of equivalence and radiation in uniformly accelerated motion is answered. (auth)

2446 DISPERSION RELATIONS AND DIFFRACTION SCATTERING. P. T. Matthews and A. Salam (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 21: 823-8(Sept. 1, 1961). (In English)

An approximate formula for high-energy elastic scattering is derived from dispersion relations. It is of the form describing conventional diffraction scattering, with a strong forward peak, the width of which is related to the interaction range. The approximations are crude, but bear promise of a more accurate treatment. (L.N.N.)

2447 POSSIBLE BOUND Σ-Λ SYSTEM. Y. Nambu and J. E. Shrauner (Univ. of Chicago). Nuovo cimento (10), 21: 864-6(Sept. 1, 1961). (In English)

Recent experimental evidence tends to favor an assignment of odd relative Σ-Λ parity. The Λ can then be considered as a bound systemof a Λ and π in an S state, with the scalar $\Sigma\Lambda\pi$ coupling constant being of the order of unity. The coupling constant is more or less determined by the binding energy if the latter is small enough. Interactions between Λ's and Σ's through pion exchange are reported, neglecting temporarily the coupling to the Ξ N system. Because of scalar coupling, a Yukawa potential with an exchange character $V = g^2 \exp[-\mu r]/r\ P_x\ P_s$ is obtained, where r is the meson mass, and P_x and P_s are the space and spin exchange operators. The Yukawa is replaced by the Hulthen potential, and the binding energies thus obtained are represented tabularly. Plots are given for the variational estimates of binding energy versus core radius for different coupling constants. The binding energy was found to be very sensitive to g^2 and the details of the short wave potential. A strong tendency for a bound state formation is quite likely. (L.N.N.)

2448 ASYMPTOTIC CONDITION IN THE LORENTZ GAUGE. M. Wellner (Indiana Univ., Bloomington). Nuovo cimento (10), 21: 867-8(Sept. 1, 1961). (In English)

It is shown that if the asymptotic condition is $A^{\mu}_{in}(x) = A^{\mu}_{in} + \frac{1}{2} M\, \partial^{\mu} \partial_{\nu} A^{\nu}_{in}(x)$ with A^{ν}_{in} obtained from $\lim_{y^0 \to -\infty} \int d^3y\, [-A^{\mu}(y)\, \partial/\partial y^0\, D(x-y) + D(x-y)\, \partial/\partial y^0\, A^{\mu}(y)]$, then $\Box A^{\mu}_{in} = O$ and $[A^{\mu}_{in}(x), A^{\nu}_{in}(y)] = ig^{\mu\nu} D(x-y)$ follow immediately from $[A^{\mu}_{in}(x), A^{\nu}_{in}(y)] = i(g^{\mu\nu} - \partial^{\mu}\partial^{\nu}) D(x-y)$. It therefore seems that the first two relations define the correct limit in the case of the interacting photon. (L.N.N.)

2449 EXISTENCE OF A STABLE NEUTRAL MESON. I. Goldberg (Univ. of Michigan, Ann Arbor) and L. F. Landovitz. Nuovo cimento (10), 21: 869-71(Sept. 1, 1961). (In English)

A stable neutral meson is described. Strong and weak interactions, and experiments designed to observe this particle are discussed. It is shown that if a scalar or pseudoscalar boson is odd under charge conjugation, it is stable or extremely long lived in the absence of neutral lepton currents. (L.N.N.)

2450 CONSEQUENCES OF UNITARY SYMMETRY FOR WEAK AND ELECTROMAGNETIC TRANSITIONS. N. Cabibbo and R. Gatto (Università, Rome and C.N.E.N., Frascati, Italy). Nuovo cimento (10), 21: 872-7(Sept. 1, 1961). (In English)

Under the condition of invariance under the 3-dimensional unitary group, the strong-interaction Lagrangian is assumed to consist of a part invariant under the unitary group, plus a "correction" breaking the invariance. Properties that follow for weak and electromagnetic amplitudes and for the assumption that symmetry-breaking "corrections" can be neglected, are examined. It is found that the K^0 (or $\bar{K}^0$) electromagnetic form factors must be zero; the charged K form factors must be equal to the charged pion form factors; and there are simple stringent relations between the form factors of the baryons and vector mesons, between the electromagnetic amplitudes from vector to pseudoscalar mesons, between the amplitudes of χ^0 and π^0 decay, and between weak interaction amplitudes. These relations depend in part on the particular representation adopted for the baryons. (L.N.N.)

2451 NEW DETERMINATION OF THE K^+-DECAY BRANCHING RATIOS. Byron P. Roe (Univ. of Michigan, Ann Arbor), Daniel Sinclair, John L. Brown, Donald A. Glaser, John A. Kadyk, and George H. Trilling. Phys. Rev. Letters, 7: 346-8(Nov. 1, 1961). (UCRL-9866)

Meson (K^+) decay branching ratios are determined and compared with previous data. The high efficiency for conversion of gamma rays from mesons (π^0) into electron pairs and the ease of recognition of electrons in a xenon bubble chamber were used to separate the K^+ decay modes in this experiment. Results and comparisons are presented in tabular form. (L.N.N.)

2452 INTERACTIONS OF LAMBDAS WITH PROTONS. Gideon Alexander, Jared A. Anderson, Frank S. Crawford, Jr., William Laskar, and Lester J. Lloyd (Univ. of California, Berkeley). Phys. Rev. Letters, 7: 348-51(Nov. 1, 1961). (UCRL-9867)

Results for $\Lambda + p \rightarrow \Lambda + p$ and $\Lambda + p \rightarrow \Sigma^0 + p$ reactions, based on a sample of 5000 Λ's produced in the Alvarez 72-in. hydrogen bubble chamber, are presented. An upper limit to the reactions $\Lambda + p \rightarrow \Lambda + p + \pi^0$ and $\Lambda + p \rightarrow \Lambda + n + \pi^+$ is set. Graphical and tabular representations are given. (L.N.N.)

2453 $\pi^+ + p$ AND $\pi^- + p$ TOTAL CROSS SECTIONS FROM 8 TO 20 BEV/c. S. J. Lindenbaum, W. A. Love, J. A. Niederer, S. Ozaki, J. J. Russell, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 7: 352-4(Nov. 1, 1961).

The gaseous Cherenkov counter was turned to a pressure which selected pions rather than protons or antiprotons. Six counters of different area were used to extrapolate the measured transmission to zero area. Corrections for muon, electron, and proton contamination and for accidentals, mainly in the end counter array, were made. Results, represented graphically, show that the momentum of the system is defined to ~±2.5% and that the absolute scale of the momentum is uncertain by 2%. (L.N.N.)

2454 EXISTENCE OF TWO T = 0 VECTOR MESONS. J. J. Sakurai (Univ. of Chicago). Phys. Rev. Letters, 7: 355-8(Nov. 1, 1961).

Recently discovered vector meson states are interpreted within the framework of the vector theory of strong interactions (Sakurai, J. J., Ann. Phys. 11, 1(1960) and Nuovo

Cimento 16, 388(1960)). Attention is concentrated on the two distinct T = 0 vector mesons unambiguously predicted by the above theory. (L.N.N.)

2455 BINARY COLLISION EXPANSION OF QUANTUM STATISTICAL PAIR PROPAGATOR. S. Fujita (Université, Brussels). Physica, 27: 930-9(Oct. 1961). (In English)

The binary collision expansion of the pair propagator, which is closely related to the grand canonical pair distribution function, is obtained in terms of quantum statistical Feynman-type diagrams. The result may be summarized by stating that the pair propagator can be expanded in a manner in which all interaction lines, representing potentials ν of the usual perturbation diagrams, are replaced by sets of ladder diagrams representing binary collision kernels B^2; and whenever a double ladder structure occurs in the diagrams, the statistical factor $(1 \pm f_1)$ $(1 \pm f_2)$ (f being the Bose or the Fermi distribution function) associated with the intermediate lines with momenta p_1 and p_2 should be replaced by $(1 \pm f_1)(1 \pm f_2) - 1$. (auth)

2456 RADIATION DAMPING AND EQUATION OF MOTION IN CLASSICAL ELECTRODYNAMICS. I. Prigogine (Université, Brussels and Univ. of Chicago) and F. Henin. Physica, 27: 928-4(Oct. 1961). (In English)

Equations for radiation damping and for the motion in classical electrodynamics are obtained using Lorentz's non-relativistic approximation, which corresponds to the change of energy through radiation given by the Larmor formula. The equations derived reduce to the basic equations of Lorentz and Lamor for slow motion. However when the acceleration changes appreciably over a period of time, then the situation becomes deeply different because of interference with the sin transform. If the acceleration acts over a time which is very short then no radiation is emitted at all. (N.W.R.)

2457 SCATTERING BY THE SCREENED COULOMB POTENTIAL. B. L. Moiseiwitsch (Queens Univ., Belfast). Proc. Phys. Soc. (London), 78: 616-18(Oct. 1, 1961).

The accuracy of the second Born approximation to the cross sections for particle scattering by a central potential is investigated. Results were unsatisfactory for partial waves associated with small values of l, but were satisfactory for all other partial waves and for all partial wave for sufficiently high impact energies. For the cases with unsatisfactory results, an exact numerical integration method may be substituted. (L.N.N.)

2458 SYMMETRY OF THE STRONG INTERACTION IN THE FOUR DIMENSIONAL ISOTOPIC SPIN SPACE AND IN THE THREE DIMENSIONAL k-SPACE. Seitaro Nakamura (Tokyo Univ.) and Shigeo Sato. Progr. Theoret. Phys. (Kyoto), 26: 231-50(Aug. 1961). (In English)

Without using strangeness a variant theory of higher symmetry is proposed for the strong interactions of baryons. Baryons are classified into two groups: $(pn\Xi^0\Xi^-)$ called the p-group and $(\Sigma^+\Sigma^0\Sigma^-\Lambda)$ called the q-group in terms of a new quantum number $k_3 = \frac{1}{2}$ for the p-group and $k_3 = -\frac{1}{2}$ for the q-group. p and q make a spinor in the three-dimensional k-space. Each group is, in turn, considered to represent a vector in the four-dimensional isotopic spin space, called N-space, which can be reduced to define two sets of spin matrices τ and ζ, the sum of the third components of which are related to the electric charge of baryons: $Q_c = \tau_3 + \zeta_3$. In order to give an interaction Hamiltonian symmetric in k-space and also in N-space, which are orthogonal to each other, 16 kinds of mesons with spin 0 which mediate the strong interactions of the Yukawa type among baryons are introduced. Under the requirement of rotational invariance for the interaction Hamiltonian in the N-k space, the character of mesons is naturally defined. It is shown that pions correspond to the component of $k_3 = 0$, $k = 0$; strangeness-two mesons to $k_3 = 0$, $k = 1$; and kaons to $k_3 = \pm 1$, $k = 1$. Two kinds of kaons, one called K-kaons exclusively coupling nucleons with the Σ- and Λ-particles and the other called L-kaons coupling the Ξ-particle with the Σ- and Λ-particles are introduced. It is shown that the scheme covers the current theory of higher symmetry and the strangeness rule, with the additional selection rule $\Delta k_3 = 0$ which enables forbidding the processes: $\Xi^- + p \rightarrow \Lambda + \Lambda$, $D^- + p + p \rightarrow \Sigma^+ + \Lambda$, etc. A number of experiments in hyperon-meson physics are, therefore, proposed which permit a selection between this scheme and the current theory. (auth)

2459 NAMBU MODEL FOR ELEMENTARY PARTICLES AND THE COMPOSITE MODEL FOR PION. Chiaki Ihara (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 26: 270-2(Aug. 1961). (In English)

The Nambu model is a dynamical model of elementary particles based on an analogy with the theory of superconductivity. An example of the theory with a finite pion mass, in which the γ_5 invariance is violated, is shown. It is indicated that the Nambu model can be related to the actual pion-nucleon phenomena through the previous treatment of the composite model for the pion, while the latter is given the firm foundation by the former. (L.N.N.)

2460 TEST OF THE INTERMEDIARY BOSON THEORY. Seitaro Nakamura (Tokyo Univ. and Nihon Univ., Tokyo) and Kunio Itami. Progr. Theoret. Phys. (Kyoto), 26: 274-7(Aug. 1961). (In English)

Energy spectra of electrons emitted in β, Λ, and Σ decay are measured, using the Tanikawa theory of universal Fermi interactions in terms of intermediary action of bosons with baryon numbers. Results are represented graphically. (L.N.N.)

2461 K^--p INTERACTIONS AT 1.15 Bev/c. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 26: 278-81(Aug. 1961). (In English)

Calculations show that the resonance phenomena in K^--p scattering, which are expected at approximately 675 Mev, are due to strong interaction in the I = 0, $d_{3/2}$ state. (L.N.N.)

2462 FIELD THEORY OF NUCLEON-NUCLEON SCATTERING. Iwao Sato (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 26: 281-3(Aug. 1961). (In English)

The one-pion-exchange and two-pion-exchange parts of the S matrix are calculated for nucleon interactions using field theory. They are decomposed into partial wave amplitudes, and the phase shifts are calculated. Calculations and experimental results for proton interactions at 310 Mev are compared, and serious discrepancies appear. This suggests the importance of meson(π) interaction effects. (L.N.N.)

2463 CONTACT INTERACTION OF MESONS IN THE NUCLEON-NUCLEON COLLISIONS. B. T. Vavilov. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 90-3(May-June 1961). (In Russian)

An attempt was made to find a perfect model for meson scattering by mesons. An additional term $\lambda\varphi$ is added to the interaction hamiltonian $H_1 = g\bar{u}\Gamma u\varphi + \lambda\varphi^4$, where $\bar{u}$ and u are the operators of nucleon generation and annihilation, $\varphi = \varphi^+ + \varphi^-$ is the sum of the operators of meson production and annihilation, Γ coincides with γ^5 or the single matrix, depending on the selection of the meson-nucleon bond (the model $\lambda\varphi^4$ was previously applied for π-π scattering by Bogolyubov and Slurkov in the Introduction to Quantum Field Theory, Gostekhizdat, 1957). (R.V.J.)

2464 ON THE ANGULAR ASYMMETRY OF LONGITUDINALLY POLARIZED ELECTRONS. Meng-ha Li. Vestnik Moskov. Univ., Ser. III, 16: No. 4, 73-4(July-Aug. 1961). (In Russian)

The angular distribution of longitudinally polarized electrons scattered by longitudinally polarized electrons was studied in order to analyze parity nonconservation. The angular asymmetry was found for cases where the initial and final spins are considered simultaneously. (R.V.J.)

2465 SPECTRA OF PRIMARY AND SECONDARY ROENTGEN RADIATION. An Experimental Study with Scintillation Spectrometer Techniques. Gunnar Hettinger. Thesis, Lund, Sweden, University of Lund, 1960. 17p.

The source of primary radiation was a commercial x-ray generator. No change in intensity or spectral shape was observed in the experiments. The comparison of the spectra of primary radiation with theory and clinical radiation is discussed. The geometry, theory, and clinical radiation of secondary radiation are also discussed. Most of the data referred to was obtained in five previous papers. (P.C.H.)

Neutron Physics

Refer also to abstract 1316

2466 (AAEC/E-66) NEUTRON DIFFUSION FORMULAE FOR HOMOGENEOUS, AXIALLY SYMMETRIC, ANISOTROPIC MEDIA, FOR MONTE CARLO APPLICATIONS. J. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1961. 10p.

Probability distributions and mean values relating to the diffusion of monoenergetic neutrons in a homogeneous but anisotropic medium are derived, as a basis for studies of Monte Carlo calculations of radial and axial diffusion coefficients in heterogeneous systems. The generalization of diffusion theory for application to anisotropic media is also discussed. (auth)

2467 (GA-2189) MEAN TIME OF EMISSION OF NEUTRONS FROM PULSED NONMULTIPLYING ASSEMBLIES. D. E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 5, 1961. Contract AT(04-3)-314. 8p.

An explicit method is given for calculating the time spent by neutrons in a homogeneous assembly initially excited by a fast burst of monoenergetic neutrons. (J.R.D.)

2468 (ORNL-3216) NEW SOLUTIONS OF THE BOLTZMANN EQUATION FOR MONOENERGETIC NEUTRON TRANSPORT IN SPHERICAL GEOMETRY. Walter Kofink (Oak Ridge National Lab., Tenn.). Nov. 17, 1961. Contract W-7405-eng-26. 92p.

Solutions of the Boltzmann equation for monoenergetic neutron transport in spherical geometry are derived which are respectively singular and regular at the center of the sphere. A few specific partial singular solutions are presented. The regular solutions in spherical geometry are constructed by superposition of solutions in plane geometry which belong to the same κ. Finally, the solutions are compared with their representations by a series of spherical harmonics. (D.L.C.)

2469 (UCRL-5918-T) MONTE CARLO SCHEMES FOR NEUTRON MIGRATION USING IMPORTANCE SAMPLING AND SPLITTING. E. L. Kaplan (California. Univ., Livermore. Lawrence Radiation Lab.). [nd]. Contract [W-7405-eng-48]. 18p.

Monte Carlo methods using importance sampling and splitting are proposed for estimating the effectiveness of neutron shields. As usual, the aim is to increase the number of particles that go through or around the shield, this increase being compensated by a decrease in the weights of these particles. With suitable modifications, the ideas are applicable to other Monte Carlo problems. One way of using splitting and Russian roulette is to require that the weight of each particle be approximately equal to a specified function of the coordinate. The proposed form of importance sampling uses a cross section for particle collisions that is the product of the neutron cross section (or its square root) with a linear function of the cosine of the angle between the particle direction and some preferred direction. The probability density of this cosine itself is taken proportional to the reciprocal of this same linear function. This function is adjustable on both a regional and an over-all basis. (auth)

2470 (AEC-tr-4668) RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS REACTORS. A translation of "Rezonansnoe Pogloshchenie Neitronov v Geterogennykh Reaktorakh." V. V. Orlov, G. V. Golashvili, and A. I. Vaskin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 15p.

A formula is obtained for the effective resonance integral of an absorbing block surrounded by a moderator. Allowance is made both for the scattering and slowing down of neutrons in the block and for the possibility of neutron passage through the block. Thus, in the limiting cases of small and large blocks, the resulting formula reduces to the formulas of Gurevich and Pomeranchuk, and Wigner, respectively. Results are given of numerical calculations of the effective resonance integral as a function of block dimensions, scattering cross section in the block, and temperature. (auth)

2471 (AEC-tr-4691) MEASUREMENT OF THE SLOWING DOWN LENGTH OF FISSION NEUTRONS TO 1.44 ev (INDIUM RESONANCE) IN BAKED BERYLLIUM OXIDE. A translation of "Izmerenie Dliny Zamedleniya Neitronov Deleniya v Spechennoi Okisi Berilliya do Energii 1.44 ev (Rezonans Indiya)." I. F. Zhezherun, I. P. Sadikov, V. A. Taraban'ko, and A. A. Chernyshov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnol Energii). 1960. 21p.

The slowing down density at $E_r = 1.44$ ev was measured for a point source of fission neutrons in BeO at distances up to 90 cm from the source. The square of the slowing down length L_f^2 was 92 ± 1.5 cm^2 to In resonance (for a BeO density $\rho = 2.79$ g/cm^3). (auth)

2472 (AEC-tr-4707) THREE DIMENSIONAL ANGULAR AND ENERGY DISTRIBUTION OF NEUTRONS IN MULTI-COMPONENT UNBOUNDED MEDIA. Translation of "Prostranstvenno-Energeticheskoe Uglovoe Raspredelenie Neitronov v Mnogokomponentnykh, Vklyuchaya Vodorod, Bezgranichnykh Sredakh." I. G. Dyad'kin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 26p.

The exact solutions were determined for the kinetic equation for the moderation of neutrons which was previously derived. Universal formulas for the calculation of the three-dimensional energy and angular distribution of neutrons in multi-component media were developed by generalizing the procedure for these calculations. Numerical results were obtained for ordinary reactor moderators and for media which are of interest in neutron logging of oil wells. (auth)

2473 (AEC-tr-4711) EFFECT OF RESONANT STRUCTURE OF CROSS SECTIONS ON THE DIFFUSION OF NEUTRONS. A translation of "Vliyanie Rezonansnoi Struktury Sechenii na Diffuziyu Neitronov." A. A. Luk'yanov and V. V. Orlov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 20p.

Neutron slowing down and diffusion is examined in media with resonances in the neutron absorption and scattering cross section regions. Expressions are derived for the absorption and scattering cross sections, averaged over resonances, and for the diffusion coefficient, with allowances for self-screening of the resonances and the Doppler broadening. The results are applied to calculation of average cross sections and the diffusion coefficient in media containing U^{238} nuclei. (J.R.D.)

2474 (AEC-tr-4719) ALBEDO EQUATIONS IN THE THEORY OF DIFFUSION AND SLOWING DOWN OF NEUTRONS. A translation of "Al'bednye Uraveniya v Teorii Diffuzii i Zamedleniya Neitronov." V. V. Orlov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 23p.

Equations for the albedo and for the neutron transmission function of flat, cylindrical, and spherical layers of reactor moderator material are formulated within the framework of the diffusion many-group approximation. Corresponding equations in the continuous slowing-down model are also obtained. (J.R.D.)

2475 SOLUTION OF THE ONE-VELOCITY BOLTZMANN EQUATION WITH THE FIRST-ORDER ANISOTROPIC SCATTERING IN PLANE GEOMETRY. R. Żelazny, A. Kuszell, and J. Mika (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Ann. Phys. (N. Y.), 16: 69-80(Oct. 1961).

The Case method, developed originally for the solution of the one-velocity Boltzmann equation with isotropic scattering of neutrons, is adapted to the solution of the one-velocity Boltzmann equation with the first order anisotropic scattering. Besides the general theory, a solution of the albedo problem for a half space is given as an illustration. (auth)

2476 THERMAL NEUTRON FLUX SPECTRUM IN A MEDIUM WITH A TEMPERATURE DISCONTINUITY. D. A. Kottwitz (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng., 7: 345-54(Apr. 1960).

The energy-dependent diffusion equation in the heavy gas approximation is considered for the case of a medium which has absolute temperature T_1 in one halfspace and T_2 in the other. The steady-state solution for F(x,E), the neutron flux per unit energy, is obtained in the absence of sinks and sources. Although the formal series solution diverges under certain conditions, it can be summed by means of the Euler transformation. Two approximation schemes giving sample analytical results are discussed. Numerical results for flux spectra and the total neutron density are presented for the case in which the temperature ratio is 2:1. The connection between this work and the theory of irreversible processes is briefly indicated. (auth)

Nuclear Properties and Reactions

2477 (ANL-6405) ISOMERIC CROSS-SECTION RATIOS FOR SOME (n,γ) AND (α,xn) REACTIONS. Carl T. Bishop (Argonne National Lab., Ill.). Aug. 1961. Contract W-31-109-eng-38. 159p.

Isomeric cross section ratios for several nuclear reactions in the medium mass region were measured. The cross section ratios of isomers produced by the thermal neutron irradiation of Se^{80}, Rh^{103}, Pd^{108}, Te^{128} and Cs^{133} were measured. Isomeric cross section ratios for the formation of the isomeric pair In^{110} and In^{110m}, produced in the Ag^{107} (α,n) and the Ag^{109} (α,3n) reactions were also measured at several energies of the incoming projectile. He ions were accelerated to a maximum energy of 43 Mev. The relative amounts of the isomers produced in the reactions were determined by scintillation counting. In the case of the In^{110} isomers the efficiencies of the scintillation counter for detecting each isomer were measured, so that absolute cross sections as well as cross section ratios could be determined for these isomers. The isomeric cross section ratios were also calculated theoretically using a statistical model, in which angular momentum effects were included. By comparing experimentally measured cross section ratios for the formation of isomeric pairs to the calculated ratios, information about the dependence of the nuclear level density on angular momentum was obtained. (auth)

2478 (ANU/P-218) SOME PHOTODISINTEGRATION REACTIONS IN THE TITANIUM ISOTOPES. T. R. Sherwood and W. E. Turchinetz (Australian National Univ., Canberra). [1961]. 14p.

Results of measurements are reported on photonuclear reaction cross-sections in Ti^{46}, Ti^{47}, Ti^{48}, Ti^{49}, and Ti^{50}. (J.R.D.)

2479 (ANU/P-232) GAMMA RAYS FROM THE Al^{27} (p,γ) REACTION. S. Bashkin and T. R. Ophel (Australian National Univ., Canberra). [1961]. 13p.

Measurement results are reported on gamma radiation spectra and angular distributions at the 759, 766, 773, and 993 kev resonances of the Al^{27}(p,γ) reaction. (J.R.D.)

2480 (ANU/P-236) SOME REACTION CROSS SECTIONS FOR COPPER AND NICKEL FROM 13.9 TO 14.9 MEV NEUTRON ENERGY. R. N. Glover and E. Weigold (Australian National Univ., Canberra). [1961]. 14p.

Absolute cross sections for the reactions Cu^{63}(n,2n) and Cu^{65}(n,2n) at 14.77 Mev, and ratios of these cross sections at 13.86 to 14.77 Mev were obtained. Cross sections for the reactions Ni^{58}(n,p), Ni^{58}(n,np) and Ni^{58}(n,2n) at 13.86 to 14.88 Mev were also measured. (J.R.D.)

2481 (BNL-694) NEUTRON CROSS SECTION EVALUATION GROUP NEWSLETTER NO. 5, OCTOBER 1961. Rudolph Sher and Sophie Moore (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 10p.

Recent information on neutron cross section data received by the BNL Cross Section Evaluation Center is reviewed. (M.C.G.)

2482 (IDO-16692) AN EVALUATION OF THE KRIEGER-NELKIN METHOD FROM CALCULATIONS OF SLOW NEUTRON SCATTERING BY CH_4. H. L. McMurry, G. W. Griffing, W. A. Hestir, and L. J. Gannon (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 25, 1961. Contract AT(10-1)-205. 47p.

The differential scattering cross section $\sigma(E_0,\epsilon,\hat{p}_0\cdot\hat{p})$ of a material for neutrons tells the probability that a scattering event involving a neutron energy of E_0 will cause an energy change ϵ and a change in direction from $\hat{p}_0$ to $\hat{p}$. Calculations of neutron energy distributions, mean free paths, etc., in a material require a knowledge of $\sigma(E_0,\epsilon,\hat{p}_0\cdot\hat{p})$. When E_0 is near kT and less than the energy for breaking chemical bonds in the material the theory for calculating σ is complicated. A recent approximate method devised by Krieger and Nelkin to simplify the calculation of the neutron differential scattering cross section σ for gases is discussed. The accuracy of the K.N. approximation was evaluated by using it to calculate σ values for methane and comparing these with results from a more rigorous, but much more time consuming, calculation which avoids most of the K.N. simplifications. Calculations were made up to 0.306 ev energy which is sufficient to excite the two lowest methane vibrations. The agreement is best when E_0 is too low to excite vibrations, but it is still good at 0.306 ev. Over this energy range the K.N. method should yield good values for methane of such quantities as the total cross section $\sigma(E_0)$, average energy loss per collision, etc. Further simplifications are needed to make it possible to calculate σ for any gas over the entire range of energies where chemical binding and thermal motions are important. (auth)

2483 (JINR-D-690) S-MATRIX FOR THE ONE-DIMENSIONAL SCHRÖDINGER EQUATION. S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 18p.

An equation was derived in which the kinetic energy $v' = 2(E - u)$ plays the role of a variable with respect to which the differentiation is being made. This equation is equivalent to the one-dimensional Schrödinger equation. An explicit expression for the S-matrix was written and its expansion in ever-convergent series was found. In the simplest case the zero term of expansion of the matrix S corresponds to the absence of reflection and coincides with WK3 approximation. The first term gives superbarrier reflection, in particular, the formula obtained by I. Goldman and A. Migdal. By means of another expansion of S-matrix, the correction to the connection formulas were found. (auth)

2484 (NP-10931) NUCLEAR COLLECTIVE MOTION AND THE SHELL MODEL. Technical Report No. 7. Raymond A. Sorensen (Carnegie Inst. of Tech., Pittsburgh). [1961]. Contract Nonr-760(15)-NR-012-202. 17p.

Talk given at the Gatlinburg Conference on Electromagnetic Lifetimes and Properties of Nuclear States, October 5-7, 1961.

It is shown that collective effects which are connected with the independent particle aspects of nuclear structure can be incorporated into the shell model in terms of an interaction between pairs of shell model particles. The Hamiltonia, the short range force, the long range force, quadrupole vibrations, and other collective effects are discussed. It was concluded that below 2 to 3 Mev the only collective effects observed are the quadrupole effects and for this reason, the simple Hamiltonian including only pairing and $P^{(2)}$ in addition to the spherical shell model one-body force gives agreement with a large class of nuclear data in this energy range. (M.C.G.)

2485 (NP-10958) SOLUBLE MODEL OF A BREAK-UP PROCESS. H. M. Nussenzveig (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 50p. (Notas de Fisica Vol. VII, No. 14, p.261-309).

The exact solution of a one-dimensional problem, representing the scattering of a particle by another one which is bound to a fixed center of force, is given. All the interactions have zero range and are described by boundary conditions. The possible processes are elastic scattering and break-up of the bound system. The elastic scattering and break-up amplitudes are explicitly determined, and the behavior of the corresponding cross-sections is discussed. At high energies, the incident particle tends to transfer its whole momentum to the bound one, giving rise to a strong peak in the break-up cross-section. The analytic behavior of the amplitudes is examined. The Riemann surface of the elastic scattering amplitude has three sheets. The break-up threshold gives rise to cubic-root branch points. The remaining singularities are a finite number of poles. The exact amplitudes are compared with those given by the impulse approximation, in first and second order, and by Born's approximation. It is found that these approximations are reliable only at high incident energies and within the width of the dominant peak of the break-up cross-section. (auth)

2486 (NP-10960) EFFECT OF $2p_0-2p_{\pm1}$ COUPLING ON THE CROSS SECTION FOR EXCITATION OF THE 1s−2p TRANSITION OF ATOMIC HYDROGEN BY PROTON AND ALPHA PARTICLE IMPACT. B. G. Skinner (Queen's Univ., Belfast). [1959]. 11p.

Calculations are carried out on the processes $H(1s) + H^+$ (or He^{++}) $\rightarrow H(2p) + H^+$ (or He^{++}) by the distortion approximation modified to include allowance for $2p_0-2p_{\pm1}$ coupling. It is found that this coupling increases the maximum cross section for the 1s−2p transition from 1.57 πa_0^2 to 1.67 πa_0^2 in the H^+ case and from 5.35 πa_0^2 to 6.02 πa_0^2 in the He^{++} case. The effect on the separate components, $1s-2p_0$ and $1s-2p_{\pm1}$ is very much greater. (auth)

2487 (NP-10974) DISPERSION DE DEUTERONES DE 28,1 Mev POR HIDROGENO, LITIO, CARBONO Y ALUMINIO. INFORME NO. 54. (Scattering of 28.1 Mev Deuterons by Hydrogen, Lithium, Carbon and Aluminum. Report No. 54). R. J. Slobodrian (Argentina. Comisión Nacional de Energia Atomica, Buenos Aires). 1961. 32p.

Natural lithium, polyethylene, and aluminum targets were bombarded with 28.1 Mev deuterons. The outgoing particles were analyzed with a scintillation spectrometer. The angular distributions for the following processes were measured: $Li(d,d')Li$, $Li^7(d,d')Li^{7*}-4.61$ Mev, $Li^7(d,t)Li^6$, $C^{12}(d,d')C^{12}$, $C^{12}(d,d')C^{12*}-4.43$ Mev, $C^{12}(d,p)C^{13*}-3.68$ Mev, $Al^{27}(d,d')Al^{27}$, $Al^{27}(d,d')Al^{27*}-2.21$ Mev, and $H^1(d,p)H^2$. The angular distributions of the inelastic processes are due predominantly to direct nuclear interaction; there is no significant compound nucleus contribution. The $Li^7(d,d')Li^{7*}-4.61$ Mev angular distribution can be adjusted by superimposing direct reaction curves corresponding to $l = 0$, $a = 3.4f$ and $l = 2$, $a = 3.9f$, where a is the interaction radius and l the angular momentum change; this leads to an odd parity assignement for the level. The $Li^7(d,t)Li^6$ angular distribution is adequately adjusted with a "pick-up" curve corresponding to $l = 1$ and $a = 5f$. The angular distribution of the reaction $C^{12}(d,d')C^{12*}-4.43$ Mev is adjusted by superimposing the curves of $l = 1$, $a = 4.1f$ and $l = 2$, $a = 4.6f$. The $C^{12}(d,p)C^{13*}-3.68$ Mev angular distribution is well adjusted by superimposing the curves of $l = 1$, $a = 3.9f$, consistently with the known spin and parity change, instead the one belonging to the reaction $C^{12}(d,p)C^{13}$ is adjusted by superimposing curves of $l = 1$ and $l = 3$ with $a = 3.5f$. The $Al^{27}(d,d')Al^{27*}-2.21$ Mev angular distribution is adequately adjusted with a curve of $l = 1$, $a = 5.1f$; therefore it follows an odd parity assignment for the level. The possible spin assignments of the levels are discussed. The angular distribution of the interaction $H^1(d,p)H^2$ is consistent with the measurements performed at neighboring energies and agrees with the curve obtained with a Serber type force. The elastic scattering angular distributions show the usual diffraction pattern and interaction radii for the deuteron-nucleus system were calculated using an optical analogy. The inelastic scattering curves yield some evidence of a total spin flip of the deuteron in the reaction. (auth)

2488 (NP-10975) DISPERSION ELASTICA E INELASTICA DE DEUTERONES DE 27,6 Mev POR Ni. INFORME NO. 55. (Elastic and Inelastic Scattering of 27.6 Mev Deuterons in Ni. Report No. 55). S. Mayo and

J. Rosenblatt (Argentina. Comisión Nacional de Energia Atomica, Buenos Aires). 1961. 16p.

Elastic and inelastic differential cross sections in Ni(d,d)Ni with 27.6 Mev deuterons were measured with the aid of scintillation technique. Charged particle spectra from the reaction were observed at laboratory angles of 15 up to 150 degrees, showing the presence of Q-positive stripping protons and elastic and inelastic deuteron groups. Due to isotopic mixture in natural Ni and the rather high level density above 2 Mev of excitation in most of those isotopes, only inelastic deuteron groups going to the first excited states in Ni^{58} and Ni^{60} could be identified. Elastic angular distribution exhibits similarities to that obtained by Yntema at 21.6 Mev, showing the typical diffraction patterns. At backward angles, a slight growing in the cross-section was observed which was not observed at 21.6 Mev. By regarding the elastic scattering like a classical light diffraction by a black disk, an interaction radius of 6.8 ± 0.8 f was derived. Inelastic angular distributions were fitted by semiclassical Butler et al. theory and Huby-Newns theory. Due to above-mentioned limitations level mixtures could not be avoided; however, a group of deuterons going to Ni^{58} 1.45 Mev, probably mixed with Ni^{60} 1.33 Mev, could be identified as proceeding via direct interaction with $l = 2$ and interaction radius 6.7 f and 6.9 f, respectively. Another inelastic group identified as Ni^{58} 2.46 Mev mixed with Ni^{60} 2.50 Mev is well fitted by $l = 2$ plus $l = 4$ and interaction radius 8.9 f and 8.7 f respectively, showing direct interaction behavior. Contributions to the above processes from compound nucleus formation are small as can be seen from absolute cross sections above 50 degrees. Total cross section for the formation of compound nucleus is about 860 mbarn. According to selection rules for deuteron scattering, 2^+ is assigned to levels 1.45 Mev and 2.46 Mev in Ni^{58}; however this assignment is not definitive due to background from levels in Ni^{58} and Ni^{60} present at those excitation energies. (auth)

2489 (NP-10976) RELATIVISTIC PARTIAL WAVE ANALYSIS. A. J. Macfarlane (Imperial Coll. of Science and Tech., London). [1961]. 35p.

Partial wave analyses of particle reactions of the type $A + B \rightarrow C + D$ and $A + B \rightarrow 1 + 2 + \ldots + N$ are discussed. The work of Joos on the partial wave analysis of their matrix elements in relativistic form was extended. The procedures to be followed for the treatment of the general case were developed and explicit formulas were derived for the case of 3 outgoing particles. It was found to be essential for all production reactions to adopt a fully relativistic approach to partial wave analysis. Formulas for projecting partial amplitudes out of full matrix amplitudes were derived. Moller's formulas for the invariant cross sections for reactions were developed into explicit forms suitable for use in connection with the partial wave analysis. The particles treated were relativistic particles of arbitrary masses and spins. The Clebsch-Gordan series of P for the case of the direct product is discussed. (M.C.G.)

2490 (TID-14040) QUADRUPOLAR NUCLEAR RELAXATION IN THE III-V COMPOUNDS. Robert L. Mieher (Illinois. Univ., Urbana). [1961]. 55p.

The results of nuclear quadrupolar spin-lattice relaxation time, T_1, measurements in most of the III-V compounds and germanium are presented and discussed. It is shown that the T_1's may be correlated with the quadrupole interaction for a free atom and appear to be relatively insensitive to different properties of the materials except for the Debye temperature. A theoretical derivation of the transition probabilities for a point charge zincblende lattice is given. This derivation follows Van Kranendonk's treatment for the NaCl lattice. An attempt is made to relate the point charge model to the III-V compounds with the aid of experimental multiplication factors. A theoretical derivation, which is based on the spin temperature concept, and an experimental verification of the dependence of the quadrupolar relaxation time on the nuclear spin are given. The spin dependence, $1/T_1 \propto f(I) = (2I + 3)/I^2 (2I - 1)$, is important in the interpretation of other experimental data. A theoretical derivation is given of a relaxation time that is isotropic as the orientation of the static field is varied with respect to the crystalline axes. This apparently accounts for the absence of an experimental observation of any systematic variations of the relaxation time with crystal orientation. An experimental investigation of the temperature dependence of quadrupolar relaxation is reported. The observed temperature dependence verifies Van Kranendonk's predictions for a Raman "two phonon" process. Debye temperatures of several III-V compounds are obtained from the temperature dependence of the relaxation times. (auth)

2491 (TID-14145) THE INTERACTION OF TRITONS WITH MATTER. William Newberry Bishop (Oak Ridge National Lab., Tenn.). June 1961. Contract [W-7405-Eng-26]. 100p.

Thesis submitted to Univ. of Florida, Gainesville.

In experiments using tritons from the Li^6(n,α) reaction, an upper limit of 300 mb was found for the (t,p) cross section on B, C, and Al. The ranges of 2.736-Mev tritons in Xe, Kr, Ni, Ar, Al, air, N$_2$, and polystyrene were measured and corresponding energy losses calculated and compared with literature values. (D.L.C.)

2492 (TID-14186) DEUTERON-INDUCED REACTIONS. Annual Report, October 1, 1960–September 30, 1961. Report No. 5. H. J. Hausman (Ohio State Univ. Research Foundation, Columbus). Oct. 27, 1961. Contract AT(11-1)-503. 41p.

Work on the He^3 acceleration program is reported. Data are presented on the spectrum and attenuation of cyclotron background radiation by concrete of various thicknesses; a shielding wall will be constructed around the cyclotron for scattering experiments. Proton reaction cross section measurements in the mass range of A = 40 to 70 are reported. Spectra of protons scattered from thin targets of Sc^{45}, V^{51}, Mn^{55}, Cu^{65}, and natural Cu are presented together with spectra for α particles from Cu(p,α), the Ti^{45} annihilation radiation from Sc^{45}(p,n)Ti^{45}, and the Fe^{55} x ray from Mn^{55}(p,n)Fe^{55}. Some optical model computations for proton-induced reaction cross sections are reported. Experiments being conducted on the (p,n) reactions at 6.7 Mev of elements of $A \approx 70$ to investigate the proton strength function maximum are described. (D.L.C.)

2493 (TID-14206) CALCULATIONS OF INELASTIC NEUTRON CROSS SECTIONS FOR EVEN-EVEN NUCLEI, A = 46-100. R. W. Jackiw, M. A. Rothman, and D. M. Van Patter (Bartol Research Foundation, Swarthmore, Penna.). Sept. 25, 1961. Contract AT(30-1)-1679. 141p.

Theoretical inelastic neutron scattering cross sections were calculated using the method of Hauser and Feshbach, for thirty even-even nuclei ranging from Ti^{46} to Mo^{100}, and for selected neutron energies within the range of 0.8 to 3.3 Mev. For a few cases, transmission coefficients obtained from three different diffuse surface complex potential wells were used. Calculations were made for all nuclei listed using the potential parameters given by Beyster et al, and for many of them using the potential parameters given by Emmerich. For many of the nuclear levels considered, several different values of spin were included, particularly for those states whose spins are not presently well established. (auth)

2494 (TID-14223) TEMPERATURE DEPENDENCE OF THE NEUTRON TRANSPORT CROSS SECTION IN PARAFFIN AND POLYETHYLENE. L. J. Esch [(Knolls Atomic Power Lab., Schenectady, N. Y. Nov. 1961)]. Contract [W-31-109-Eng-52]. 16p.

The temperature dependences of the neutron transport cross sections in paraffin and polyethylene were calculated with the aid of a modified Radkowsky prescription. The temperature dependence of the thermal neutron diffusion length in paraffin was determined experimentally, and the transport cross section was calculated therefrom and compared with Radkowsky values. (D.L.C.)

2495 (TID-14256) NUCLEAR PHYSICS LABORATORY PROGRESS REPORT, NOVEMBER 1, 1960—OCTOBER 31, 1961. (Case Inst. of Tech., Cleveland. Nuclear Physics Lab.). Contract AT(11-1)-720. 47p.

Experimental Research. Instrumentation developments are described, including a pulsing modification of a Van de Graaff accelerator, a tape readout system for a pulse height analyzer, and other laboratory instrumentation. Progress is reported for numerous nuclear reaction projects. Results of a Mn^{55}(p,n) study are discussed. Neutron spectra and angular distributions from B^{11}(d,n) reactions at 3 Mev are presented for various excited C^{12} states and their implications discussed in detail. Instrumentation for n-γ correlation work and for lifetime and gyromagnetic ratio measurements in excited nuclear states is described. Theoretical Research. Various projects in theoretical nuclear physics are described. Results of (d,p) stripping reaction analysis are described briefly. (D.L.C.)

2496 (TID-14261) A TECHNIQUE FOR MEASURING THE NEUTRON CAPTURES IN BORON AND URANIUM-235. D. A. Gavin, D. J. Anthony, T. F. Ruane, and P. J. Tetrault (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. Contract [W-31-109-Eng-52]. 18p.

Paper to be presented at the American Nuclear Society Meeting, Chicago, Illinois, November 6-10, 1961.

A technique to measure the neutron captures in B and U^{235} was developed on the basis of a calibration of the (n,γ) reaction with a known neutron flux. Experiments which were conducted in the Plastic Mockup Assembly to measure the neutron captures in fuel and spiked poison in slab cores PMA-44, -45, and -46 are described. (D.L.C.)

2497 (UCRL-6552) ON VELOCITY-DEPENDENT NUCLEAR POTENTIALS (thesis). Eugene H. Canfield (California. Univ., Livermore. Lawrence Radiation Lab.). July 21, 1961. Contract W-7405-eng-48. 47p.

For optical-model scattering or single-particle energy-level calculations, a one-to-one correspondence may be established between typical static and velocity-dependent nuclear potentials. It is shown how to choose potentials for one model with which one can duplicate any given scattering result or energy level calculated from the other model. As an example, a velocity-dependent neutron well is found which not only reproduces a given static scattering result, but also has an inherent energy dependence closely approximating the empirical dependence imposed on the static optical-model calculations. A similar neutron well reproduces the sequence of least-bound energy levels as a function of atomic number calculated from a static single-particle model. (auth)

2498 (UCRL-9683) EJECTION OF LARGE FRAGMENTS IN HIGH-ENERGY NUCLEAR REACTIONS (thesis). Vitor Pereira Crespo (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 6, 1961. Contract W-7405-eng-48. 78p.

Several features of the production of Na^{24} and Mg^{28} fragments produced in the interaction of protons and He ions with Cu, Ag, Au, and U were investigated. Formation cross sections were determined for He ions of different energies between 320 and 880 Mev and for protons of 700 Mev. Thick-target recoil experiments were performed at bombarding energies of 0.7 and 3 Bev for protons, and 880 Mev for He ions. Also given are some recoil measurements of Na^{24} from Al. Analysis of data obtained with target materials heavier than Al showed that for the bombarding energies used, Na^{24} and Mg^{28} are probably produced by the cleavage of the target nucleus into two heavy fragments. One of these fragments has a mass approximately equal to the mass Na^{24} or Mg^{28} and the other contains most of the remaining mass of the target nucleus. However, Na^{24} and Mg^{28} are very probably not slowly evaporated particles nor products of a slow fission process. The experimental information covering fragmentation from photographic emulsion studies and radiochemical studies is discussed. The various mechanisms proposed are considered and a new one suggested. According to this new mechanism, Na^{24}, Mg^{28}, and the more energetic fragments observed in nuclear emulsions are ejected promptly from the parent nucleus by very complex nucleon-nucleon cascades and by collective effects. (auth)

2499 (AEC-tr-4141(p.91-100)) DISTRIBUTION OF CHARGE IN ATOMIC NUCLEUS (NEW METHODS OF INVESTIGATION). B. Kuchowicz. Translated from Nukleonika, 2: No. 2, 335-46(1957).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3170.

2500 (AEC-tr-4665) YIELD OF SOME FRAGMENTS DURING THE FISSION OF Th^{232} BY 14.3 MEV NEUTRONS. A translation of "Vykhody Nekotorykh Oskolkov pri Delenii Th^{232} Neitronami s Energiei 14.3 Mev." V. A. Vlasov, Yu. A. Zysin, I. S. Kirin, A. A. Lbov, L. I. Osyaeva, and L. I. Sel'chenkov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 12p.

The relative and absolute fragment yields of Ca^{73}, Br^{83}, Sr^{89}, Y^{91}, Zr^{95}, Mo^{99}, Ag^{111}, Cd^{115}, Te^{129m}, Te^{132}, and Ce^{141} during the fission of Th^{232} by 14.3-Mev neutrons were determined by a radiochemical method. A method based on the weighted sums of the observed relative yields of all the fission fragments obtained from the interpolated curve of their mass distribution was used for the determination of the absolute yields. The errors involved in this method are discussed. (auth)

2501 (AEC-tr-4680) FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION FOR THE ISOTOPE Mo^{100}. A translation of "Sechenie Radiatsionnogo Zakhvata Bystrykh Neitronov Izotopom Mo^{100}." V. A. Tolstikov and Yu. Ya. Stavisskii (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 5p.

The dependence of the fast neutron radiative capture cross-section for Mo^{100} on energy, at 30 to 2100 kev, was measured by the activation method. (J.R.D.)

2502 (AEC-tr-4718) GAMMA RADIATION IN ELASTIC INTERACTION BETWEEN FAST NEUTRONS AND ATOMIC NUCLEI. A translation of "Gamma-Izluchenie pri Neuprugom Vzaimodeistvii Bystrykh Neitronov s Atomnymi Yadrami." V. B. Nefedov, V. P. Popov, and Yu. S. Yazvitskii (U.S.S.R. Sovet Ministrov. Glavnoe

Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 20p.

An investigation was conducted on the gamma radiation spectra excited by neutrons at 14 Mev in Li, Be, C, O, Mg, Al, Fe, and Cu. The spectra were measured with a paired scintillation spectrometer. (J.R.D.)

2503 (AEC-tr-4720) ANGULAR BETA-GAMMA CORRELATION IN THE DECAY OF La-140 AND Ce-141. A translation of "Uglovaya β-γ-Korrelyatsiya pri Raspade La-140 i Ce-141." V. P. Rudakov (Adademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 6p.

Also published in Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 24: 1124-5(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 12119.

2504 (JPRS-11068) INVESTIGATION OF THE GAMMA RADIATION ACCOMPANYING THE BOMBARDMENT OF Mg^{24}, Mg^{25}, Mg^{26} WITH Po-ALPHA RADIATION IN HUNGARY. Eva Csongor. Translated from Magyar Fiz. Folyoirat, 8: 357-415(1960). 81p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31626.

2505 NUCLEAR RESONANCE FLUORESCENCE. A. Berinde. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: No. 1, 233-59 (1961). (In Rumanian)

The resonance absorption of electromagnetic radiations occurs when the energy of the incident photon corresponds exactly to the difference between the energy of the excited level and the ground state of the absorbing atom. Quanta emitted by atoms of the same type as the absorbing ones may be used as initial photons, the absorption and reemission of which results in resonance fluorescence; the nuclear resonance fluorescence is the nuclear analog of the similar optical phenomenon. Work in this field received a great impetus from Mössbauer's discovery of the recoilless emission and absorption of γ-radiation. The present state of knowledge on the field of resonance cross section, the effect of concurrent processes, such as Compton diffusion, Rayleigh, Thompson, and Delbrück diffusion, the thermal and mechanical methods of investigation, the use of the recoil of disintegrations prior to emission, nuclear reactions as sources of resonance γ-radiation, and the application of recoil resonance fluorescence for the study of β-decay are reviewed. (84 references). (TTT)

2506 NUCLEAR ELECTRIC QUADRUPOLE MOMENTS OF ^{121}Sb AND ^{123}Sb. F. Leś (Jagellonian Univ., Krakow). Acta Phys. Polon., 20: 775-82(1961). (In English)

The hyperfine structure of the line 3030 Å ($5\ p^3\ {}^2P^0_{1/2}$ — $5\ p^2 6s\ {}^2P_{3/2}$)Sb I was investigated with a hollow cathode discharge tube as light source and an interferometer with multilayer dielectric mirrors as high resolving power instrument. The quadrupole coupling constant was determined for the $5\ p^2 6s\ {}^2P_{3/2}$ level of the Sb^{121} nuclide and, with the electric field gradient for the configuration p^2s, the electric quadrupole moment of the Sb^{121} nucleus was obtained. The quadrupole moment of the Sb^{123} nucleus was computed from the ratio Q_{123}/Q_{121}. The results, without Sternheimer's corrections, are: $Q(Sb^{121}) = (-0.54 \pm 0.08) \times 10^{-24}$ cm^2 and $Q(Sb^{123}) = (-0.69 \pm 0.10) \times 10^{-24}$ cm^2. (auth)

2507 TWO-BODY POTENTIALS AND EXCITED STATES OF NUCLEI. I. J = 0 — 2 ENERGY LEVEL SPLITTINGS. P. Tarjanne (Inst. of Tech., Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 64, 1-9(1960). (In English)

The J = 0 — 2 energy level splittings in even-even nuclei are predicted by using a Signell-Marshak-like potential and calculating the interaction matrix elements by an approximation method due to Moshinsky. The absolute values found are of the correct order of magnitude; the relative values are correct to within an error of 10% for the 22 nuclides investigated. (auth)

2508 ON THE NATURAL RADIOACTIVITY OF SAMARIUM. Matti Karras (Univ. of Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 65, 1-30(1960). (In English)

The natural radioactivity of samarium was studied by measuring, using a grid-type ion chamber, the α spectra of natural Sm and of sources enriched in Sm^{148} and Sm^{149}. A spectrum line width of 120 kev was obtained. The alpha energies (in Mev) and half lives (in years) of Sm^{147}, Sm^{148}, and Sm^{149} were found to be 2.20 ± 0.02 and $(1.17 \pm 0.05) \times 10^{11}$, 2.14 ± 0.03 and $(1.2 \pm 0.3) \times 10^{13}$, and 1.84 ± 0.05 and $(4 \pm 2) \times 10^{14}$, respectively. Alpha-decay systematics of the rare-earth nuclides is briefly discussed. (L.N.N.)

2509 DETERMINATION OF THE MEAN BETA DISINTEGRATION ENERGY OF S^{35} BY MEANS OF AN ISOTHERMAL MICROCALORIMETRIC METHOD. Vaeinoe Hovi and Lasse Niemelae (Univ. of Turku, Finland). Ann. Acad. Sci. Fennicae, Ser. A, VI, No. 83, 1-9(1961). (In English)

An isothermal microcalorimeter was constructed and calibrated for measurements of radioactive beta disintegration energies at liquid nitrogen, which was caused by heat leaks into the innermost Dewar, was found to be of the order of 3.5 microwatts. The calibrated measuring accuracy of the microcalorimeter was about 1%. By using this apparatus the mean beta disintegration energy of S^{35} was determined. As the final result from several measurements, the value 54.8 kev was found. (auth)

2510 OPTICAL MODEL WAVE FUNCTIONS FOR STRONGLY ABSORBING NUCLEI. N. Austern (Univ. of Pittsburgh). Ann. Phys. (N. Y.), 15: 299-313(Sept. 1961).

The extent to which nuclei can appear "black" is discussed and shown to be limited. WKB calculations are shown to be especially suitable in the case of strong absorption and to explain many detailed features of exact calculations. It is seen why direct reaction calculations sometimes show the oscillatory angular distributions which are characteristic of "surface reactions." Study of the wave function just outside the nuclear surface leads to a model for the scattering amplitudes for a strongly absorbing nucleus, permitting a physically-based smoothing of the "sharp-cutoff model." (auth)

2511 ELECTROMAGNETIC EFFECTS OF THE NUCLEON SPIN-ORBIT INTERACTION. Albert Arking (Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N. Y.), 15: 314-36(Sept. 1961).

The nucleon spin-orbit potential is examined for its effects on electromagnetic processes of H^2, H^3, and He^3. Since only magnetic terms are affected by velocity-dependent potentials, the magnetic dipole moment operator due to the spin-orbit potential is derived and the contributions to the N-P capture cross-section and to magnetic moments of H^2, H^3, and He^3 are calculated. Only the T = 0 component of the spin-orbit force has any effect on these quantities. The contribution to the unpolarized capture cross section for the Signell-Marshak (SM) and Gammel-Thaler (GT) potentials is much too small to be measured and even in a polarization measurement the effect is somewhat too small to be observed. Any hope of increasing the range and depth of the spin-orbit potential to bring agreement between theory and experiment for N-P capture must be abandoned because of the enormous contribution to the magnetic moments. The contribution to the three-body moments—-0.07 nm for the SM potential and -0.06 nm for the GT potential—is too large to be reconciled with present experimental knowledge of the magnetic moments and theoretical knowledge of the three-body wave function and meson and relativistic effects. (auth)

2512 COINCIDENCE STUDIES ON THE DECAYS OF Bi^{206} AND Bi^{205}. C. J. Herrlander (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 71-92(1961). (In English)

Using electron-electron and electron-gamma coincidence techniques the decays of Bi^{206} and Bi^{205} are investigated. The measurements on Bi^{206} are in good agreement with earlier results. In the decay of Bi^{205} the following, previously proposed, excited levels are confirmed: 262.8, 703.3, 761.0, 987.6, 1013.8, 1043.7, 1614.6, 1766.4, 2566.5, and 2609.9 kev. The coincidence measurements indirectly suggest a new level in Pb^{205} at 2.3 kev, mainly populated via a 260.5 kev transition from the 262.8 kev level. By studying the internal-conversion electrons following the α-decay of Po^{209} the new level is unambiguously proved, since the K-lines of the two transitions of 260.5 and 262.8 kev are found to be present with the same intensity ratio as in the decay of Bi^{205}. Furthermore a new level of 1499.4 kev in Pb^{205} is established. (auth)

2513 ON NUCLEAR $f_{5/2}$, $p_{3/2}$, $p_{1/2}$ LEVEL SPACINGS AND TRANSITION PROBABILITIES IN THE LEAD REGION. I. Bergstroem, C. J. Herrlander, P. Thieberger, and J. Uhler (Royal Inst. of Tech., Stockholm and Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 20: 93-115(1961). (In English)

A search for transitions of the type $f_{5/2} \rightleftharpoons p_{1/2}$ was made in Pb^{205}, Pb^{203}, Pb^{201}, and Hg^{201}. In Pb^{205} this transition has an energy of only 2.3 kev and goes directly to the $f_{5/2}$ ground state. In Pb^{203} the corresponding transition has an energy of 126 kev and a half life of 75 ± 3 ns. In Pb^{201} and Hg^{201} there was no evidence of a half life longer than about 2 ns. It was essential to work out methods for a systematic search of half lives in the ns-region in cases where the production of the nuclides to be studied leads to complicated mixtures of isotopes decaying by electron capture. Changes of the $f_{5/2}$, $p_{3/2}$, and $p_{1/2}$ level spacings and transition probabilities with the nucleon number are studied and compared with theory. The agreement between experiments and the predictions of Kisslinger and Sorensen for Pb^{205} and Pb^{203} is shown to be fairly good. (auth)

2514 ENERGY LEVELS IN O^{19} OBTAINED BY THE REACTION $O^{18}(d,p)O^{19}$. Bo Sjoegren, Gunilla Wickenberg, and Nils Johansson. Arkiv Fysik, 20: 117-34(1961). (In English)

The protons from deuteron bombardment of O_2^{18} gas are analyzed in a magnetic spectrometer. The deuteron energy is about 7 Mev and the proton spectra are measured at laboratory angles 52.3 and 90.8°. Apart from the groups already known eight new groups from $O^{18}(d,p)O^{19}$ are identified corresponding to the following states in O^{19}: 1.257, 2.353, 2.765, 3.047, 3.144, 3.791, 3.942, 4.109 ± 0.030 Mev. Of these the first one is observed only at 90.8°. One of the 2.353 and 2.765 Mev levels may be identified with a theoretically predicted $9/2+$ state having the configuration $(d_{5/2})^3$. Preliminary values of the absolute differential cross-sections are also given. The target technique and the necessary corrections are discussed. (auth)

2515 GAMMA-GAMMA ANGULAR CORRELATION MEASUREMENTS IN Gd^{152}. Z. Grabowski (Univ. of Uppsala). Arkiv Fysik, 20: 177-82(1961). (In English)

The gamma-gamma angular correlation of three cascades in Gd^{152} is investigated. The measured cascades are (kev): 1280 to 344, 1100 to 344 and 790 to 344. The measurements give the following spin assignments of the energy levels in Gd^{152}: 1625 kev 2^-, 1445 kev 3^+, and 1134 kev 3^-. (auth)

2516 DETERMINATION OF THE 7.0×10^{-9}-SECOND HALF-LIFE OF THE 134 KEV EXCITED STATE IN MERCURY 197. T. Suter, P. Reyes-Suter, and T. R. Gerholm (Inst. of Physics, Uppsala). Arkiv Fysik, 20: 183-6(1961). (In English)

The half life of the first excited state in Hg^{197} was measured by delayed electron-electron coincidence technique. The value of $(7.0 \pm 0.2) \times 10^{-9}$ sec was obtained. (auth)

2517 DETERMINATION OF A 2.8 NSEC HALF-LIFE FOR THE FIRST EXCITED STATE IN Au^{195}. Pilar Reyes-Suter and Tito Suter (Inst. of Physics, Uppsala). Arkiv. Fysik, 20: 187-92(1961). (In English)

The half-life of the 61.5 kev level in Au^{195} was measured by delayed electron-electron coincidence technique. The value 2.8 ± 0.3 nsec was obtained. The $L_I : L_{II} : L_{III}$ subshell ratios of the 61.5 kev transition was determined with an iron-free double focusing spectrometer and have the value $121 \pm 2 : 108 \pm 2 : 100 \pm 2$. The mixing ratio E 2/M 1 computed from these ratios is 0.17. Transition probabilities were computed and compared with the corresponding values for the 77 kev transition in Au^{197}. An upper limit $T_{1/2} < 0.2$ nsec was measured for the 261 kev level in Au^{195}. (auth)

2518 ANGULAR ANISOTROPY OF THE FISSION OF EVEN-EVEN NUCLEI. V. G. Nesterov, G. N. Smirenkin, and I. I. Bondarenko. Atomnaya Energ., 11: 248-50(Sept. 1961). (In Russian)

The dependence of the angular anisotropy of fission fragments resulting from the fission of U^{233} and U^{235} by neutrons in the energy range from 0.2 to 2.5 Mev was investigated by means of an experimental device containing 4 fission chambers. The arrangement made it possible to record simultaneously the fission fragments in the direction of the beam and perpendicularly to it, originating from two fissioning layers of U^{233} and U^{235}. The measurements were carried out on a Van-de-Graaff generator making use of the $T(p,n)He^3$ reaction for producing fast neutrons. A 75-kev solid T target was used, together with a detector having an angular resolution of 9°. The results indicated that threshold values of the first 2 channels agree well with J. Hill and J. Wheeler's (Phys. Rev. 89, 1102 (1955)) data, being -1.47 and -0.72 Mev for U^{233}, -0.6 Mev for U^{235} and -1.61 and -0.72 Mev for Pu^{239}. (TTT)

2519 THE PRACTICAL USES OF ISOMERS. Yu. V. Petrov. Atomnaya Energ., 11: 250-1(Sept. 1961). (In Russian)

In the interaction of slow neutrons with isomers, in addition to radiative capture (n,γ) and elastic scattering (n,n), a second-order inelastic scattering (n,n') is also possible resulting in the removal of part or of all of the excitation energy of the isomer by the neutron. For Hf^{180m} which has a half-life of 5.5 hrs, the probability of the (n,n') reaction is comparable to that of radiative capture and the cross section of the reaction in the thermal range amounts to several hundred barns. This reaction may be used for supplying moderated neutrons for the fission threshold of U^{234} and Pu^{240}, increasing the multiplication factor and facilitating the control of reactors employing such fuels. (TTT)

2520 UPPER LIMIT OF THE HALF LIFE OF THE 351-KEV EXCITED LEVEL OF Pr^{143}. Serge Gorodetzky, Robert Manquenouille, Raymond Richert, and Albert Knipper. Compt. rend., 253: 428-9(July 17, 1961). (In French)

A recent study of the decay of Ce^{143} led to the conclusion that the 294-kev γ radiation has a predominantly E_2 multipolarity, however, not excluding the possibility of a M_1 mixture. In order to better define the multipolar character of this radiation, the period of the 351-kev level of Pr^{143} was measured. The β-γ delayed coincidences were measured with a time-amplitude converter. It was concluded that the 351-kev level has an upper limit $T_{1/2} < 10^{-10}$ sec. On the basis of the variation in the theoretical and experimental values for the conversion coefficients and the K/L ratio, no evaluation could be made on the multipolarity. However, the upper limit of the 351-kev level seems to favor a strongly predominant M_1 polarity in agreement with the $g_{7/2}$ of the shell model. (J.S.R.)

2521 STUDY OF THE STRIPPING REACTION OF THE DEUTERON BY 14.1-MEV NEUTRONS. Claude Bonnel and Philippe Levy. Compt. rend., 253: 635-7 (July 24, 1961). (In French)

A study of the stripping reaction (n + d → n + n + p) by neutrons at 14.1 Mev was made at two angles. The results obtained were compared with previous results and with theoretical predictions. (tr-auth)

2522 EXPERIMENTAL AND CALCULATED CROSS-SECTIONS FOR THE Bi^{209} (p, xn) Po REACTION AT A PROTON BOMBARDING ENERGY OF 135 MEV. B. N. Belyaev, A. V. Kalyamin, and A. N. Murin (Khlopin Radium Inst., Academy of Science, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 337-9(Sept. 11, 1961). (In Russian)

The cross-sections for the formation of the isotopes Po^{200} to Po^{209} were determined experimentally. The Po samples were prepared by electrodeposition from HCl onto polished silver dishes. The α-activity was measured on a 31-channel ionization chamber. The intensity of the α-lines was compared with the intensity of the Po^{206} α-line, and the relative yields were obtained from the known ratios of the probability of α-decay to E-capture from the various polonium isotopes. The relative yields of Po isotopes undergoing E-capture primarily were determined on a 4 π-scintillation counter from the activity of daughter products of Po such as Bi, Pb, and Tl which were isolated radiochemically. An internal standard was used to correct for chemical yield. The yield of Po^{200} and Po^{201} were corrected with respect to the yield of Po^{203}, the yield of Po^{203} with respect to the yield of Po^{205}, and the yield of Po^{205} with respect to the yield of Po^{206}. The absolute cross-section of the $Bi^{219}(p,4n)Po^{206}$ reaction was measured from the yield of the $Al^{27}(p,3pn)Na^{24}$ reaction. The experimental cross-sections were compared with theoretical values obtained from calculations on a digital computer with the use of a Monte Carlo method (1170 proton collisions with the nucleus were calculated). A "cascade-evaporative" model was assumed. The density of the nuclear levels was determined on the basis of a Fermi-gas model. The calculated fission cross-section for Bi bombarded with 135-Mev protons was found to be 95 ± 13 mb. This value is in good agreement with a fission cross-section of about 80 mb determined radiochemically by Jodra, and with a cross-section of about 125 mb determined by Steiner in an ionization chamber. (TTT)

2523 ANISOTROPY OF FISSION FRAGMENTS $I_0/I_{90°}$ DURING THE FISSION OF U^{233} WITH NEUTRONS HAVING AN ENERGY OF 100 TO 1000 KEV. V. A. Shigin (Kurchatov Inst. of Atomic Energy, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 351-3(Sept. 11, 1961). (In Russian)

Neutrons were obtained from $T(p,n)He^3$ and $Li^7(p,n)Be^7$ reactions by impinging an accelerated beam of protons onto a tritium or lithium target which was at a distance of about 2 meters from the walls of the measuring unit. Layers of U^{233} (~2 mg/cm²) were deposited on both sides of a plane aluminum ring placed at an angle of 45° to the direction of the proton beam. The fission fragments from each layer were counted independently. The chamber could be rotated through an angle of 180° to eliminate errors due to improper centering or to differences in counting efficiencies. The chamber was clad with a 0.5 mm Cd jacket to decrease the background count due to scattered neutrons. Over a wide range of neutron energies (160 to 1000 kev) the anisotropy was found to be relatively large and constant ($I_0/I_{90°}$ = 1.05 to 1.09). At a neutron energy of 85 kev, the value of $I_0/I_{90°}$ = 1.02. These results are in good agreement with values for the anisotropy of U^{233} reported in the literature at neutron energies at 500, 700, and 1000 kev. (TTT)

2524 THE DEPENDENCE OF NUCLEAR γ–EMISSION PROBABILITIES ON THE MOMENTA PARTICIPATING IN TRANSITION. M. E. Voikhanskii (Leningrad Chemico-Pharmaceutical Inst.). Izvest. Vysshikh Ucheb. Zavedenĭĭ, Fiz., No. 3, 103-8(1961). (In Russian)

Radiative transitions of multiplicity $L = [I_i \text{ to } I_f] + 1$ are investigated. It was found that the statistical multiplier $S(I_iLI_f)$ participating in the formulas of Vaiskopf-Moshkovskii for transition probabilities differ from the magnitudes $S(I_iLI_f)$ for the transitions $L = [I_i \text{ to } I_f]$. In M1 + E2 or E1 + M2 transitions consideration of $S(I_iLI_f)$ results in various effects, depending on the initial and final spin states. The investigation indicates a strong dependence of I → I transitions on spin magnitudes. (tr-auth)

2525 NEW ISOTOPES OF EMANATION AND FRANCIUM: ^{223}Em, ^{224}Em, AND ^{224}Fr. A. V. Bellido (Universidad Nacional San Agustin, Arequipa, Peru). J. Inorg. Nuclear Chem., 19: 197-203(Oct. 1961). (In English)

An examination of the products of the interaction of thorium with 230 Mev protons revealed evidence for the existence of the neutron-excess isotopes: Em^{223}, Em^{224}, and Fr^{224}. The existence of these three new isotopes was confirmed by identification of their decay products: Ra^{223} and Ra^{224}. (auth)

2526 REDETERMINATION OF THE HALF-LIFE OF BISMUTH (ThC). K. R. Applegate, E. M. Morimoto, M. Kahn, and J. D. Knight (Univ. of New Mexico, Albuquerque). J. Inorg. & Nuclear Chem., 19: 375-6(Oct. 1961). (In English)

The half life of bismuth-212 (ThC) was redetermined during the investigation of the chemical properties of carrier-free lead-212 deposited on platinum surfaces. A half life of 60.60 minutes, with a standard deviation of 0.043 minutes, was determined. The procedure for the determination is given. (P.C.H.)

2527 THE HALF-LIFE OF Br^{83}. B. J. Bowles (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 19: 380-1(Oct. 1961). (In English)

Samples of Br^{83} were prepared, by the (n,γ) (gamma) reaction of pile neutrons with natural metallic selenium and with selenium enriched to 82% in Se^{82}, by the fission of natural uranium with pile neutrons and by the fission of thorium, uranium, and plutonium with protons of 30 and 50 Mev. A summary of a least squares fit, weighted according to the variance on each point of the decay curves, is given. Considering these results, a value of 144.6 ± 1.0 minutes is proposed for the half life of Br^{83}. (P.C.H.)

2528 THE EXPERIMENTAL DETERMINATION OF FAST FISSION FACTORS IN LIGHT WATER-MODERATED, SLIGHTLY ENRICHED URANIUM ROD LATTICES. E. Erdik (Brookhaven National Lab., Upton, N. Y.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 98-101(Oct. 1961).

The ratio, δ_{28}, of the fission rate in U^{238} to that in U^{235} was determined for various slightly enriched hexagonal miniature uranium rod lattices in light water. The experimental values of δ_{28} and ϵ are given for 1.0, 1.15, and 1.3 per cent fuel enrichments, 1, 1.5, 2, 3, and 4 water-to-uranium volume ratios and 0.250, 0.387, and 0.600 in. rod diameters. (auth)

2529 SOME EXPERIMENTAL DETERMINATIONS OF THE NUMBER OF PROMPT NEUTRONS FROM FISSION. A. Moat, D. S. Mather, and M. H. McTaggart (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 102-12(Oct. 1961).

The average number of neutrons per fission ($\bar{\nu}$) is measured for the spontaneous fission of Cf^{252}. A large liquid scintillation counter is then used to compare other $\bar{\nu}$ values with that of Cf^{252}. Some results obtained for prompt neutrons from spontaneous fission (SF) and neutron induced fission (NIF) are: U^{235} NIF at 75 kev, $\bar{\nu} = 2.39 \pm 0.05$; U^{235} NIF at 2.5 Mev, 2.60 ± 0.08; U^{235} NIF at 14.2 Mev, 4.28 ± 0.08; U^{238} NIF at 14.2 Mev, 4.44 ± 0.12; Pu^{240} SF, 2.13 ± 0.05; Cf^{252} SF, 3.69 ± 0.07. The results are based on the assumption that the Pu^{240} and Cf^{252} fission neutron spectra are identical; the dependence of the results on these spectra is discussed. (auth)

2530 LONG-TERM REACTIVITY CHANGES IN IRRADIATED THORIUM. D. C. C. Gibbs, M. Gibson, and W. A. Cooper (Atomic Energy Establishment, Winfrith, Dorset, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 130-9(Oct. 1961). (AEEW-R-29)

An analysis is made of GLEEP oscillator measurements on thorium cartridges before and after irradiation (1.44 neutrons/kilobarn maximum) in the NRX reactor. A simple theoretical model for neutron behavior is assumed and basic nuclear data are adjusted to enable this model to predict the GLEEP experimental results. It is found that if the neutron yield from U^{233}, η_{23}, is lowered by approximately 1 per cent the best agreement between experiment and calculation is obtained, but the discrepancy obtained using 'world' nuclear data is not significant. (auth)

2531 DIRECT MEASUREMENT OF THE HYPERFINE STRUCTURE OF THE 6 $^3P_1$ LEVEL OF THE NUCLEAR ISOMER Hg^{197}. C. Brot (Laboratoire de Chimie Physique de la Faculte des Sciences, Paris). J. phys. radium, 22: 412-16(July 1961). (In French)

The hyperfine interval $F = {}^{13}\!/_2 \rightarrow F = {}^{11}\!/_2$ in the 6 $^3P_1$ state of the nuclear isomer Hg^{197*} was measured using a recently developed double resonance method. This method depends on the observation of the wavelength change of the light re-emitted after the RF transition. The result obtained has a probable error of about 6×10^{-6}. (auth)

2532 SPECTROSCOPIC DETERMINATION OF THE SPIN OF Lu^{176} AND OF THE NUCLEAR MAGNETIC AND QUADRUPOLE MOMENT OF Lu^{175} AND Lu^{176}. Jean Blaise, Jacques Bauche, Simon Gerstenkorn, and Frank S. Tomkins (C. N. R. S., Bellevue, France). J. phys. radium, 22: 417-27(July 1961). (In French)

The hyperfine structure of several lines of Lu I and Lu II, emitted by a sample of lutetium containing 74.5% Lu^{176} and 25.5% Lu^{175}, were recorded using a Fabry-Perot spectrometer. From the ratio of intensities of the hyperfine structure components, it is deduced that $I^{176} = 7$, confirming the result of Kaliteevskiĭ and Chaika. The ratios of the moments of the two isotopes are: $\mu^{175}/\mu^{176} = 0.7109 \pm 0.0050$ and $Q^{175}/Q^{176} = 0.71 \pm 0.01$. The value proposed by Steudel, $\mu = + 2.0 \pm 0.2\ \mu_N$ is confirmed, but the value of the quadrupole moment must be revised: $Q^{175} = (4.0 \pm 0.5).1/(1 - R).10^{-24} = (5.6 \pm 0.6).1/(1 - R')\ 10^{-24}\ cm^2$, where R and R′ are the Sternheimer corrections for the 6p and 5d electrons, respectively. The results are compared with the predictions of the model of Mottelson and Nillson, the ratios of the quadrupole moments indicating that the deformations of the two nuclei are identical. (auth)

2533 ANGULAR DISTRIBUTIONS OF PHOTOPROTONS FROM Li, Al, S, Ni, AND Cu. Masayoshi Masuda (Osaka Univ.). J. Phys. Soc. Japan, 16: 1801-7 (Oct. 1961). (In English)

Thin foils of lithium, sulfur, aluminum, nickel, and copper were irradiated using the x-ray beam from a betatron at Osaka University, and angular distribution of photoprotons were obtained using a ZnS scintillation detector. The angular distribution of photoprotons obtained is classified into two broad types, one isotropic and the other forward asymmetric. Aluminum and nickel (21 Mev) belong to the former type; while lithium, sulfur, nickel (18 Mev) and copper fall under the latter type, which is represented by the theoretical form, $a + b \sin^2 \theta(1 + c \cos \theta)^2$. As an exceptional case, copper has shown an abnormal angular distribution having a maximum in the forward direction and also a rise up in the backward direction. The functional form which fits best to this distribution was calculated by a Bendix computer and compared with the recent theory of photonuclear reactions. (auth)

2534 PHOTOPROTONS FROM SILICON AND PHOSPHORUS. Katsufusa Shoda, Shoichi Shiina, Keisuke Kobayashi, Ken Abe, and Motoharu Kimura (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1807-17(Oct. 1961). (In English)

Photoprotons from Si and P produced by a 24-Mev betatron were observed in nuclear emulsions. Fine structures are observed in the energy spectrum of Si, showing a fairly similar shape to the excitation curve of Al(p,γ) reaction. The appearance of these structures is expected by resonating group model and probably by the channel coupling theory as well. The distances of the proton peaks in the spectrum are nearly equal to those expected by these theories. The type of spectrum of Si is different from that of P, and such difference seems to appear between even and odd Z neighbouring nuclei. The angular distributions for P have large maxima around 90°, but those for Si have not so large maxima and minima. This suggests that the shell structure may have some effects on the photonuclear reactions. (auth)

2535 "GAMMA RAYS FROM THE PROTON BOMBARDMENT OF SULPHUR AND THE O^+ SECOND EXCITED STATE OF ^{32}S." Yasuo Hirao (Osaka Univ.). J. Phys. Soc. Japan, 16: 1828-40(Oct. 1961). (In English)

The analysis of gamma rays from natural sulfur, separated S^{32} and S^{34} bombarded by protons up to 5.7 Mev was carried out. Excitation function of the 2.24-Mev gamma ray due to the transition (1st-ground state of S^{32}) was measured. Resonances were found at $E_p = 4.77$, 5.10, 5.35, and 5.60 Mev, which correspond to the excitation energies of 6.93, 7.24, 7.48, and 7.71 Mev of Cl^{33}, respectively. Gamma rays were observed with a single and three crystal spectrometers. In addition, using gamma-gamma cascade coincidence and sum coincidence methods, energies and decay scheme were determined as follows: S^{32}: 0.92 Mev (5th-2nd), 1.20 (6th-2nd), 1.54 (2nd-1st), 2.23 (3rd-1st), 2.24 (1st-ground), and ~4.3 (3rd or 4th-ground). S^{34}: 0.97

(7th-3rd), 1.17 (2nd-1st), 2.13 (1st-ground), 3.30 (2nd-ground), 3.91 (3rd-ground), and 4.11 (5th-ground). The 3.78 Mev gamma ray due to the transition (2nd-ground of S^{32}) was not found. The angular correlation between the cascade gamma rays of 1.54 and 2.24 Mev shows good agreement with the transition of $O^+(E2)2^+(E2)^+$. Then the 2nd state of S^{32} at 3.78 Mev has a spin of O^+. This assignment agrees with the calculation of the j-j coupling shell model. With a three crystal spectrometer, nuclear pair from the 2nd state of S^{32} at 3.78 Mev was searched. The intensity of the nuclear pair was about 2% or less of the 1.54 Mev gamma ray. The configurations of this O^+ second state and the ground state of P^{31} are also discussed. (auth)

2536 REACTION $O^{16}(\gamma,p)N^{15}$ BY 20.5 MeV POLARIZED BREMSSTRAHLUNG. Katsufusa Shoda (Tohoku Univ., Sendai), J. Phys. Soc. Japan, 16: 1841-8(Oct. 1961). (In English)

D_2O soaked, H_2O soaked, and unsoaked emulsions were irradiated simultaneously at the characteristic angle by the 20.5-Mev polarized bremsstrahlung from a thin Al target in a betatron. The linear polarization of the gamma rays at 4 Mev to 6 Mev was estimated to be 31.7 ± 5.0% by observing the azimuthal angular distribution of photoprotons from deuterons. The H_2O soaked emulsion and unsoaked one were used to study $O^{16}(\gamma,p)$ reaction. The proton energy spectrum shows a structure which agrees with the earlier results except a peak at 1.1 Mev of proton energy. This peak which has never been found corresponds to the well-known resonance in $N^{15}(p,\gamma)O^{16}$ at 1.05 Mev of proton energy. The azimuthal angular distributions of photoprotons caused by several photon energy regions were observed. From these angular distributions it is shown that a resonance at a photon energy of 17.3 Mev is E1 transition, and the corresponding level of O^{16} is considered to have $J = 1^-$, $T = 1$, which is in good agreement with the theoretical calculation in the intermediate coupling. (auth)

2537 ANGULAR DISTRIBUTION FOR THE $N^{14}(d,p)N^{15}$ GROUND STATE REACTION. Susumu Morita (Kyusyu Univ., Hukuoka, Japan), Toshiyuki Ishimatsu, Tetsuji Chô, Yutaka Nakajima, Nawoyuki Kawai, Tôru Murata, and Yûki Hachiya. J. Phys. Soc. Japan, 16: 1849-52(Oct. 1961). (In English)

Angular distributions for the $N^{14}(d,p)N^{15}$ ground state reaction were studied at the deuteron energies of 15.2 and 13.8 Mev, and were compared with the angular distributions for the $C^{12}(\alpha,p)N^{15}$ ground state reaction at such alpha-particle energies that the compound nucleus O^{16} would be produced at the same excitation energies as would be produced by the bombardment of N^{14} with deuteron of the above energies. Similar comparisons between the two reactions were made by using the available experimental results including the previous results. It is seen that the $N^{14}(d,p)N^{15}$ ground state reaction proceeds mainly via the stripping process at deuteron energies above 8 Mev showing no appreciable change of the angular distribution with deuteron energy, though the angular distribution for the $C^{12}(\alpha,p)N^{15}$ ground state reaction shows critical energy dependence in the corresponding energy range. (auth)

2538 (α,p) REACTIONS NEAR Z = 26. Itaru Nonaka (Tokyo Univ.), Hisashi Yamaguchi, Takashi Mikumo, Iwao Umeda, Tatsuro Tabata, and Saburo Hitaka. J. Phys. Soc. Japan, 16: 1853-6(Oct. 1961). (In English)

Spectra of protons from the (α,p) reactions on Ti, Cr, Fe, Ni, Cu, and Zn were measured at the energy of alpha particles near 28 Mev. For Ti and Fe the shapes of the spectra and the distributions of the observed levels of residual nuclei resemble each other. This is also true for Cr and Ni, and for Cu and Zn. Angular distributions of the first, the second and the third proton groups for Ni, and of the first and the second proton groups for Zn were all known to show the direct process type forward peaking. The integrated total cross sections of these proton groups are 0.5_4(first), 0.4_9(second) and 0.7_2(third) mb for Ni and 0.2_4(first) and 0.2_4(second) mb for Zn respectively. (auth)

2539 NUCLEAR SPIN OF PROTOACTINIUM-231 FROM HYPERFINE SPLITTING. E. W. T. Richards, A. Ridgeley, N. J. Atherton, and H. S. Wise (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Nature, 192: 444(Nov. 4, 1961).

The atomic emission spectrum of Pa^{231} was recently photographed in the region 4000 to 9000 Å. The spectrum shows pronounced hyperfine structure, the majority of lines being split into four components. This confirms the value $I = 3/2$, which was previously obtained. (P.C.H.)

2540 A PRECISION MEASUREMENT OF THE TOTAL CROSS SECTION OF Pu^{239} BETWEEN 0.00291 AND 0.1 ev. G. J. Safford and W. W. Havens, Jr. (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 11: 65-8(Sept. 1961).

The total neutron cross section of Pu^{239} was measured at seventeen neutron energies between 0.00291 ev and 0.10 ev with a crystal spectrometer. The absorption cross section was obtained by subtracting the relatively small scattering cross section from the measured total cross section. The sample used was a plutonium-aluminum metallic foil containing 1% aluminum. The isotopic content of the plutonium was 99.82% Pu^{239}, 0.15% Pu^{240}, and 0.03% Pu^{241}. The value obtained for the absorption cross section of Pu^{239} at 2200 meters/sec was $\sigma_a = 1007 \pm 8$ barns. (auth)

2541 HALF-LIVES OF RADIONUCLIDES. [PART] II. E. I. Wyatt, S. A. Reynolds, T. H. Handley, W. S. Lyon, and H. A. Parker (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 11: 74-5(Sept. 1961).

Half-lives of twenty-one radionuclides are reported. In general, the activity of a purified sample was followed for two or more half-lives. The data were analyzed by "least squares," using desk calculators or computers. Two half-life values reported previously were redetermined, with improvement. (auth)

2542 ON THE ANALYSIS OF DEUTERON STRIPPING REACTIONS. M. Nagasaki (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo cimento (10), 21: 716-21(Sept. 1, 1961). (In English)

The equivalence of the Butler approximation and the Born approximation for the deuteron reaction in the extrapolation method of determining the reduced width of the captured nucleon is verified, and the relation of the extrapolation method to the method of Bowcock is discussed. Numerical comparison is given for the particular case of $C^{12}(d,p)$ C^{13*}(3.09-Mev state) at $E_d = 2.89$ Mev. (auth)

2543 HARD-CORE EFFECTS ON THE ENERGY GAP IN NUCLEAR MATTER. G. Fano, M. Savoia, and A. Tomasini (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 21: 854-8 (Sept. 1, 1961). (In English)

It is shown that the energy gap Δ in the spectrum of free quasi-particles in nuclear matter strongly depends on the relativistic details of the interaction. (auth)

2544 INTERACTION OF PROTONS FROM BROOKHAVEN ALTERNATE GRADIENT-SYNCHROTRON WITH NUCLEAR EMULSION. P. L. Jain, H. C. Glahe, G. N. Srivastava, and P. D. Bharadwaj (Univ. of Buffalo). Nuovo cimento (10), 21: 859-63(Sept. 1, 1961). (In English)

Observations were made on 872 nuclear stars produced in Ilford K-5 emulsions 10 × 10 cm and 600 μm thick. The stack was exposed in the diffracted beam. Frequency and angular distributions were measured for stars with $N_h = 0$ and, $2 \leq N_h \leq 7$ and $N_h > 7$, and graphical representations are presented for each case. The average number of shower particles and the theoretical median angle were calculated. Individual distributions of 2-, 4-, and 6-prong events were found. Practically all showed anisotropy. (L.N.N.)

2545 ASPECTS OF THE DECAY OF ^{27}Mg AND OF ^{89}Zr. S. Monaro, G. B. Vingiani, and R. Van Lieshout (Instituut voor kernphysisch, Amsterdam). Physica, 27: 985-93(Oct. 1961). (In English)

The relative intensities of the 1.015 and 0.834 Mev gamma rays from Mg^{27} are determined to be (42 ± 2) : 100. The intensity of the positons from 79 hours Zr^{89} relative to the 0.915 Mev gamma ray, (44.5 ± 1.5 : 100), shows that $\epsilon/\beta^+ = 3.54 \pm 0.14$, is in accord with the theoretical value. A new gamma ray of 1.75 ± 0.02 Mev is observed. (auth)

2546 THE ENERGY LEVELS OF THE MAGNESIUM ISOTOPES OF MASS 25 TO 28. S. Hinds, H. Marchant, and R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 473-90(Oct. 1, 1961).

Energy levels of Mg^{25}, Mg^{26}, Mg^{27}, and Mg^{28} were measured, using a broad-range magnetic spectrograph, by means of deuteron- and triton-induced reactions. Reactions used and the number of levels observed are listed for each isotope. Ground-state Q values were also measured. (L.N.N.)

2547 NUCLEAR FINITE SIZE EFFECTS ON THE INTERNAL CONVERSION IN THE μ-MESONIC He^3 ATOM. Hajime Narumi (Doshisha Univ., Kyoto) and Shigeru Matsuo. Progr. Theoret. Phys. (Kyoto), 26: 221-30(Aug. 1961). (In English)

The internal conversion processes in the μ-mesonic He^3 atom following nuclear fusion reactions by μ mesons at low temperature are analyzed, where the finite size effects of the He^3 nucleus play an important role, so that the μ-mesonic irregular solutions outside the nucleus are considered. The calculated reaction rates give reasonable agreements with experimental results. (auth)

2548 STABILITY OF AXIALLY ASYMMETRIC NUCLEAR DEFORMATION. Jun Hiura (Hokkaido Univ., Sapporo), Shōta Suekane, and Hajime Tanaka. Progr. Theoret. Phys. (Kyoto), 26: 263-9(Aug. 1961). (In English)

The γ stability of axially asymmetric nuclear deformation is investigated on the basis of the generalized collective model. It is possible in the vibrational region to make the nonaxial deformation stable for the ground state, but it is necessary in this formalism to introduce a very strong potential to make the axially asymmetric shape stable in the rotational region. (auth)

2549 HYPOTHESIS OF THE ISOTOPIC SPIN INDEPENDENCE IN EXTREMELY HIGH-ENERGY REGION. Masaaki Kawaguchi (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 26: 277-8(Aug. 1961). (In English)

It is shown that for pion-nucleon collisions, $\pi^+ + p$ and $\pi^- + p$ in which the spin of the former is $^3/_2$ and of the latter $^3/_2$ and $^1/_2$, the total cross sections at extremely high energies tend to a constant independent of the value of the spin. Pomeranchuk's theorem, in which it was proved that the total cross section of particle A on a target B and that of the antiparticle $\bar{A}$ on the same target B have the same value, was used. (L.N.N.)

2550 ANGULAR CORRELATIONS OF GAMMA-GAMMA CASCADES IN Pb^{208}. L. Simons, M. Brenner, L. Kaeld, K-E. Nysten, and E. Spring (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 26: [No.] 6, 1-35(1961). (In English)

By measuring gamma singles and coincidence spectra from Th^{228} (RdTh) with scintillation detectors, the commonly accepted level scheme of Pb^{208} was verified within the limits of the measurements. Measurements of the relative intensities of the gamma rays largely agree with previous investigations. Angular correlation measurements yield $\delta = -0.06 \pm 0.05$, δ^2 being the mixing ratio I(E2)/I(M1), for the 511 kev gamma transition in Pb^{208}. The angular correlation of the 763 kev – (583 kev) – 2615 kev cascade in Pb^{208} was measured, and it was confirmed that the 3961 kev level has spin 6^- and that the 763 kev gamma ray is a M1 + E2 mixture with $\delta = -0.45 \pm 0.15$. Furthermore, the angular correlation measurements verify that the levels at 2615, 3198, 3475, and 3709 kev have spins 3^-, 5^-, 4^-, and 5^- in this order, that the 2615 and 583 kev transitions are pure E3 and E2 radiations respectively, and that the 860 kev transition is almost M1 radiation with $\delta = -0.023 \pm 0.010$. (auth)

2551 THE REACTION OF TEAR WITH EXCITATION OF LEVELS. I. S. Osadko. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 62-5(May-June 1961). (In Russian)

The reaction (d,p) in a non-axial nucleus is investigated. A formula was derived for the reduced probability of the excitation of rotational freedom in the nucleus. (tr-auth)

2552 THE SHAPE OF THE NUCLEUS AND ZERO SPIN EXCITED STATES. A. S. Davydov, V. S. Rostovskii, and A. A. Chaban. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 66-74(May-June 1961). (In Russian)

Collective excitations corresponding to β and γ vibrational levels of even-even nuclei are investigated. The probabilities of E0 transitions between these states and E2 transitions from zero spin levels for spherical and non-spherical nuclei at $\gamma_0 = 0$ and $\gamma_0 \pm 0$ are calculated. It is shown that the γ parameter in the rotational state theory of non-axial nuclei is identified with the most probable magnitude γ_m corresponding to zero oscillations of the nuclear surface near the point of equilibrium. (tr-auth)

2553 THE PARAMETERS OF DIPOLE POLARIZABILITY OF ATOMIC NUCLEI. S. F. Semenko. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 75-82(May-June 1961). (In Russian)

An analysis of photoneutron curves showed that the ratio of two giant resonance maximum widths in deformed nuclei is about 1.5 to 2, which contradicts the hydrodynamic model of axially symmetric nuclei. Elastic scattering of dipole γ quanta on oriented nuclei was studied, and feasibility of using the experiment for determining parameters of nuclear optical anisotropy, in particular the widths of two gigantic resonances, is discussed. (R.V.J.)

2554 SEPARATION OF SHORT-LIVED XENON AND KRYPTON FISSION ISOTOPES: DETERMINATION OF THE GAMMA RAY FROM DECAY OF Xe^{137} AND Kr^{89}. S. Prakash (Kernforschungszentrum, Karlsruhe, Ger.). Z. Elektrochem., 64: 1037-41(1960). (KFK-39) (In German)

The short-lived rare gas isotopes Kr^{89}($T_{1/2}$ = 3.2 min) and Xe^{137}($T_{1/2}$ = 3.8 min) were produced by irradiation with reactor neutrons from natural uranium. The two gases were separated from one another out of the formed gas mixture by means of fractional absorption on charcoal. The separated fission gas isotopes were investigated with a scintillation spectrometer. The energies and intensities of the gamma lines gave information concerning the excitation levels of the daughter nuclei. The results are discussed. (tr-auth)

2555 THE β SPECTRUM In^{114}. H. Daniel and Ph. Panussi (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Physik, 164: 303-7(1961). (In German)

The shape of the In^{114} β spectrum was measured with a magnetic lens spectrometer. The shape factor was found to be essentially allowed. A least square fit gave the following result for the deviation term b/W: $b = (5 \pm 2) \times 10^{-2}$ mc^2. The stated error is the standard deviation only. This result does not agree with the large deviation reported by Langer et al. Additional information is given for the isomeric transition. (auth)

2556 RADIOAKTIVNYE IZOTOPY ZOLATA-Au^{198} I Au^{199}. (Radioactive Isotopes of Gold, Au^{198} and Au^{199}). M. G. Serebryakov and M. A. Gracheva. Moscow, Atomizdat, 1960. 19p.

Production of Au^{198} and Au^{199} and preparation of sources containing these isotopes are described. Physicochemical characteristics of the isotopes and their applications in therapy of malignant tumors are discussed. The book is intended for personnel interested in medical radiology and applications of labeled atoms. (R.V.J.)

Particle Accelerators

Refer also to abstract 1976

2557 (AFCRL-152) NEGATIVE MASS CARRIER PHENOMENA BY CYCLOTRON RESONANCE TECHNIQUES. Final Report [February 15, 1959—February 15, 1961]. G. C. Dousmanis, R. C. Duncan, Jr., and B. W. Faughnan (David Sarnoff Research Center, Princeton, N. J.). Mar. 15, 1961. Contract AF19(604)-5479. 86p. (AD-256598)

An emissive cyclotron resonance, arising under optical excitation from the negative-mass branch of heavy holes in Ge, was established and studies by the use of circularly polarized microwaves. The effective mass is $-(0.26 \pm 0.06)$ m_0 as expected from the band structure. Efforts to enhance the emission, although not exhausted, leave the effect submarginal for useful application by more than an order of magnitude. The properties of Landau levels for negative masses were delineated and their relevance to emission is discussed. Evaluation was made of various proposals for uses of negative mass carrier phenomena. Another resonance was found and may arise from that part of the light holes that corresponds to the negative-mass region of the heavy holes. (auth)

2558 (BNL-5752) THE CANONICAL EQUATIONS FOR SYNCHROTRON OSCILLATIONS. Harald Hahn (Brookhaven National Lab., Upton, N. Y.). July 3, 1961. Contract [AT(30-2)-Gen-16]. 28p.

Differential canonical equations on synchrotron or phase oscillations are rederived from those reported earlier in the literature. The mathematical approach is different from that used formerly in that the Hamiltonian function is derived from energetic considerations only, and no attempt was made to separate the synchrotron and betatron oscillations. The synchrotron oscillations are obtained as an approximate solution from the general set of differential equations. (J.R.D.)

2559 (BNL-5753) FLATTENING PROCEDURE FOR EMPTY CYLINDRICAL CAVITIES. J. L. Walters (Brookhaven National Lab., Upton, N. Y.). June 1, 1961. Contract [AT(30-2)-Gen-16]. 18p.

Results of a mathematical procedure for linac cavity flattening are analyzed. The results of a previously described procedure are derived in detail to show where approximations are made. In this way, more exact relations are found. (J.R.D.)

2560 (BNL-5757) THE COSMOTRON PARALLEL PLATE VELOCITY SPECTROMETER (BEAM SEPARATOR). William J. Fickinger, Jack Sandweiss, and James R. Sanford (Yale Univ., New Haven. Sloane Physics Lab. and Brookhaven National Lab., Upton, N. Y.). [Oct. 15, 1959]. Contract [AT(30-2)-Gen-16]. 34p.

An electromagnetic velocity spectrometer or beam separator was designed for the Cosmotron to create a meson (π^+) beam. Physical principles of beam separator operation, beam separator design features, aspects of operation, and use in the meson (π^+) beam are discussed. (M.C.G.)

2561 (DESY-A2.81) A QUADRUPOLE MAGNET WITH NON-CIRCULAR APERTURE AND LINEARIZED END FRINGING FIELD. K. G. Steffen (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 14, 1961. 21p.

A new type of quadrupole magnet cross section is suggested and compared to the standard circular aperture. It is shown that a significant improvement of acceptance in phase space is gained by this design. Formulas for the acceptance per unit cost are given for the two quadrupole types. A general investigation of the acceptance of a long periodic strong-focusing channel was used as an approach to optimizing standard quadrupole parameters. Special end field configurations are suggested for quadrupole and for bending magnets. They eliminate to a large extent the nonlinear aberrations which are generally caused by the fringe fields. (auth)

2562 (MATHS Memo/58/WW) THE EFFECT OF AN ORBITAL MAGNETIC FIELD ON BETATRON OUTPUT. W. Walkinshaw and K. Wyllie (Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England). June 7, 1948. 12p.

A theoretical study was made of the effect on the electronic motion in a betatron of an applied orbital magnetic field. The application of this magnetic field results in coupling between the vertical and radial Serber type oscillations. A detailed mathematical analysis of the problem is given. A qualitative description of the essential features of the motion is included. It is shown that the coupling caused by the orbital magnetic field is likely to decrease output. (M.C.G.)

2563 (TID-13521) LINEAR ACCELERATOR PROJECT. Annual Technical Report, July 1, 1960—June 30, 1961. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 18p.

The construction of the Linear Accelerator was completed at the vendor's site and demonstration tests were performed. Progress was also made in the design and construction of auxiliary equipment needed for experiments with the Linac and in the area of reactor theory as applied to the pulsed neutron method. Among the auxiliary equipment developed were electron beam drift tube, neutron drift tubes, targets, shields for experimental research experiments, interlocks, and detector systems. (M.C.G.)

2564 (TID-14135) PHASE MEASUREMENT OF LINEAR ACCELERATOR BEAM BUNCHES. Yale Study on High Intensity Proton Accelerators. Internal Report Y-5. R. Beringer (Yale Univ., New Haven). Sept. 13, 1961. Contract [AT(30-1)-2726]. 6p.

Means for detecting and measuring the absolute phase of linac beam bunches are discussed with particular reference to the resonant electrode method. Bunch shape and length measurements are also considered. (D.L.C.)

2565 (TID-14180) LINEAR ELECTRON ACCELERATOR STUDIES AND PROPOSED TWO-MILE ACCELERATOR PROJECT. Combined Status Report, July 1 to September 30, 1961. (Stanford Univ., Calif. and Stanford Univ., Calif. W. W. Hansen Labs. of Physics). Oct. 1961. Contracts AT(04-3)-21 and AT(04-3)-363. 62p. (ML-859; M-280)

Component studies and development are described for the present Mark III and Mark IV linear electron accelerators and for the conversion of Mark IV into a model section of the proposed two-mile accelerator. (D.L.C.)

2566 (TID-14187) LINEAR ACCELERATOR PROJECT PROGRESS REPORT FOR JULY 1961 THRU OCTOBER 1961. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 10p.

The final assembly of the Linac was completed and it was placed in operation. The major difficulty encountered has to do with limited cathode emission. In order to solve this problem, the entire vacuum system was reworked and a cathode research program was begun. Development and studies were continued on equipment for neutron capture cross section measurements, neutron slow-chopper spectra measurement equipment, neutron die-away experiment targets, the REX code, time-dependent transport theory, time-dependent spectra in infinite media, time-dependent water spectra, cylindrical cell boundary conditions, IBM-704 codes for neutron thermalization studies, space and energy distribution of thermal neutrons, and effective mass kernels in neutron thermalization studies. (M.C.G.)

2567 (AEC-tr-4141(p.33-78)) ACCELERATORS. W. Zych. Translated from Nukleonika, 2: No. 2, 267-320(1957).

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 3338.

2568 (AEC-tr-4730) INVESTIGATION OF INTERACTION BETWEEN IONS AND ELECTRONS IN AN ACCELERATED BEAM OF IONS. A translation of "Izuchenie Vzaimodeistviya Mezhdu Ionami i Elektronami v Uskorennom Puchke Ionov." K. D. Sinel'nikov, B. G. Safronov, A. T. Timofeev, and Yu. I. Pankrat'ev (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 7p.

In order to investigate conditions necessary for producing a plasma beam, the interaction between ions and electrons was studied in a compensated ion beam. Compensation of the ion beam by passing through an electron cloud is negligible if the electrons are stationary, but it can be brought up to 50% if the electrons are accelerated along the beam and up to 100% if a weak longitudinal magnetic field is applied to the beam. Measurements were made of the ion current with variations of the magnetic field. The observation that the ion current is independent of the field both in the presence and absence of electrons is explained in terms of ion-electron interactions. (D.L.C.)

2569 (AEC-tr-4734) CHARGE DENSITY WAVES IN MODULATED BEAMS. A translation of "Volny Plotnosti Zaryada v Modulirovannykh Puchkakh." Ya. B. Fainberg and N. A. Khizhnyak (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 26p.

The one-dimensional problem of modulation of two unbounded electron beams is investigated with the kinetic equation and the approximation of the small signal theory. Modulation of one beam in a slow-wave waveguide is also considered. The dispersion equation for the problem is studied with allowance for different beam temperatures. (D.L.C.)

2570 (NP-tr-643) PROBLEMS AND TECHNIQUES IN EXPERIMENTS (SELECTED ARTICLES). Translated from Pribory i Tekh. Ekspt., No. 2, 146-8; 150-2(1960). 15p.

Two papers are presented concerning the measurement of ion currents in ion-accelerating systems, and the structure of a 50-kv ion-accelerating tube. Abstracts of both papers appeared previously in NSA. (B.O.G.)

2571 (NP-tr-643(p.1-8)) MEASURING THE ION CURRENT IN AN ION-ACCELERATING SYSTEM. V. A. Egorov (Yegorov), D. V. Karetnikov, and S. N. Popov. Translated from Pribory i Tekh. Ekspt., No. 2, 146-8; (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 21743.

2572 (NP-tr-643(p.9-13)) 50-kv ION-ACCELERATING TUBE. I. V. Orfanov and V. A. Teplyakov. Translated from Pribory i Tekh. Ekspt., No. 2, 150-2(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 21745.

2573 (NP-tr-810) NEW DATA ON THE DUOPLASMATRON ION SOURCE. M. V. Ardenne. Translated from Nachrichtentechnik, 10: 449(1960). 2p.

The operational characteristics of the duoplasmatron are discussed for continuous operation with hydrogen gas, as an electron generator, and for molecular ion production in nuclear-fusion experiments. (B.O.G.)

2574 (UCRL-Trans-685) A CYCLOTRON WITH AN ALTERNATING MAGNETIC FIELD FOR MULTIPLE-CHARGED IONS. A translation of "Tsiklotron s Periodicheskim Magnitnym Polem dlya Mnogozaryadnykh Ionov." V. P. Dmitrievskii, B. I. Zamolodchikov, and V. V. Kol'ga (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20232.

2575 ACCELERATION OF H^3 TO 35 MEV ENERGY IN THE 1.5-METER CYCLOTRON. N. I. Venikov, G. N. Golovanov, V. P. Konyaev, N. V. Starostin, and N. I. Chumakov. Atomnaya Energ., 11: 213-16(Sept. 1961). (In Russian)

Investigations of H^3 acceleration were undertaken using the 1.5-m cyclotron. To reduce gas consumption a recirculation was used, pressurizing the system to about 100 to 200 mm of Hg. A servomotor allowed control of the gas consumption automatically from the control board. Impurities were removed by means of liquid N_2-cooled traps. This arrangement made it possible to reduce the H^3 losses by about 2 orders of magnitude to about 5 cm^3/hr. The maximum acceleration energy was found to be about 35 Mev on the basis of the highest attainable frequency of 11.2 megacycles of the resonance circuit. The average ion current on the target was 30 microamp but was usually kept at 10 microamp. Interference of the subharmonics was negligible. (TTT)

2576 IMPROVEMENT OF THE MONOENERGETIC CHARACTER OF CYCLOTRON ION BEAMS. N. I. Venikov and N. I. Chumakov. Atomnaya Energ., 11: 247-8(Sept. 1961). (In Russian)

One of the main shortcomings of the cyclotron consists in the fact that the energy of the particles in the ion beam is widely distributed. This necessitates the application of a magnetic field on the outlet beam whenever experimental conditions require a highly monochromatic beam, resulting in a considerable loss of intensity. To remedy this, focusing diaphragms were used with excellent results at the cyclotron of the I. V. Kurchatov Institute of Atomic Energy. The positions of the slit and of the diaphragms were determined by solving graphically the differential equations referring to the motion of ions across a constant magnetic field and an electric field changing with the frequency. The undesired initial conditions, such as the presence of ions having high-amplitude radial oscillations which might cause losses during acceleration were eliminated by the diaphragm system used. Parameters are given for 3 conditions of acceleration of the deuterons to energies up to 20 Mev. (TTT)

2577 A LINEAR ELECTRON ACCELERATOR AS THE INJECTOR OF 1 BeV SYNCHROTRON. Tetsuji Nishikawa, Jiro Tanaka, Akira Miyahara, and Hiroo Kumagai (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1817-27(Oct. 1961). (In English)

The design study and the general aspect of a linear electron accelerator are described. Since this linear accelerator is used for the injector of the strong-focusing synchrotron under construction, the spread of the output energy is desired to be as small as possible. For this purpose the cause of the energy spread was re-examined and divided into two kinds; one is the different phase motions of the electrons injected at the various phase angles and the other is the variations of the microwave power, frequency, and other parameters. By the careful design, especially on the buncher, and by the use of the prebuncher and the stable power system, the output energy spread of about 3% was obtained at the energy of 6.5 Mev. (auth)

2578 A CONTRIBUTION TO THE GEOMETRIC PARAMETER CALCULATION OF AN ACCELERATING ASSEMBLY OF A HIGH FREQUENCY LINEAR ACCELERATOR. Bohumil Kvasil (Czech. Tech. Univ., Prague). Jaderná energie, 7: 289-95(1961). (In Czech.)

A new method of calculating the geometric parameter of an accelerating assembly of a linear high-frequency electron accelerator, based on stationary difference of Poynting flows, is reported. The accuracy of the method is compared with other methods. (auth)

2579 THE FEASIBILITY OF A SUPERCONDUCTING PROTON LINEAR ACCELERATOR. A. P. Banford and G. H. Stafford (National Inst. of Research in Nuclear Science, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 287-90(Oct. 1961). (In English)

The use of superconducting resonators for a proton linear accelerator is shown to reduce greatly the radiofrequency power requirements and, in principle, to make a c.w. high intensity machine practicable. Rough estimates of costs do not preclude the proposal on economic grounds. Some of the technical problems involved are also discussed. (auth)

2580 ELECTRON BUNCHING IN AN ACCELERATING FIELD. B. G. Tarasov. Vestnik Moskov. Univ., Ser. III, 16: No. 3, 35-42(May-June 1961). (In Russian)

Studies were made of electron clusters moving in an accelerating field. Formulas were derived for determining the amplitude of the beam current n-th harmonics in relation to the accelerating potential, electron path in the cluster space, and other parameters. The calculated results are in agreement with experimental data. The formulas can be applied for determining the optimum energy of each current harmonic. (tr-auth)

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Refer also to abstracts 1981, 1983, 1984, 1985, 1986, and 2763

2581 (AD-255042) TWO-FLUID MODEL FOR THE MOTION OF A RARIFIED PLASMA ACCELERATED BY INDUCTION. Technical Memorandum 10. Publication No. 1456. Alan S. Penfold (Litton Systems, Inc. Advanced Development Lab., Culver City, Calif.). Feb. 1, 1961. Contract AF49(638)-759. 29p.

Particle motion in the absence of coulomb forces is initially considered, and a single-particle model is used in which the coulomb forces are strong enough to make the plasma macroscopically neutral at all times. The effects of self-induced magnetic fields are neglected, but the results of the model show how the condition of self-field dominance is approached and that the role of self-fields is larger than suspected. The present results are valid for fields having a certain kind of axial symmetry. (D.L.C.)

2582 (AERE-R-3805) ARC INITIATION ON HEATED MOLYBDENUM EXPOSED TO A TOROIDAL HYDROGEN DISCHARGE. R. A. Dugdale, J. T. Maskrey, and R. C. McVickers (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1961. 18p.

An experimental investigation is made of arc initiation on molybdenum and other refractory metals as a function of temperature and heat treatment. The interpretation suggests that arcing stops when certain second phases dissolve at high temperatures; that there is a critical size of particle for arc initiation, which decreases with increasing specimen voltage and increasing ion current density; and that it is possible to deplete the specimen of the arc initiating impurities by combined electrical treatment and heat treatment. The latter process can be carried to the stage where a temperature-independent non-arcing state is achieved at a specimen voltage of 2 kv and ion current density of 23 A/cm^2 in a pulse of 200 μsec duration. (auth)

2583 (AFCRL-43) DISPERSION RELATIONS IN A STATIONARY PLASMA. Interim Report No. 3. B. S. Tanenbaum (Raytheon Co., Waltham, Mass.). Jan. 1961. Contract AF19(604)-5984. 81p. (AD-256060)

Linearized hydromagnetic plasma equations are derived and used to investigate the oscillations which are possible within a stationary, homogeneous, fully ionized, macroscopically neutral plasma of infinite extent. Three cases are treated: no magnetic field, a longitudinal magnetic field, and a transverse magnetic field. In the field-free case, the well-known dispersion relations for the three simplest types of plasma oscillations (longitudinal electron waves, longitudinal ion waves, and transverse electromagnetic waves) were verified, and the properties of each of these waves are reviewed. Four dispersion relations were derived for the case of a longitudinal magnetic field, two being the same as longitudinal electron and ion waves in the field-free case and the other two being ordinary and extraordinary transverse waves which at high and low frequencies agree with the magneto-ionic theory of Appleton and the magnetohydrodynamic theory of Alfven, respectively. Four solutions to the dispersion relation are again derived for the transverse magnetic field case; one of the solutions is the ordinary transverse wave of magneto-ionic theory, while the remaining three each represent complex coupled oscillations in the plane perpendicular to the field. The solutions can be arranged in a form such that one type of oscillation is identical to the extraordinary waves in magneto-ionic theory, another is quite similar to the longitudinal electron waves in the field-free case, and the third coupled oscillation reduces to a longitudinal magnetohydrodynamic wave at low frequencies, an ordinary ionic wave at high frequencies, and a new type of wave at mid-frequencies. (D.L.C.)

2584 (MATT-Q-15) QUARTERLY REPORT [ON PLASMA PHYSICS] COVERING THE PERIOD APRIL 1–JUNE 30, 1961. (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 3, 1961. Contract AT(30-1)-1238. 35p.

Experimental operation of the Model C stellarator was begun. Confinement of plasma in externally produced magnetic fields was investigated. In the quiescent cesium plasma, the rate of diffusion across the magnetic field was close to the classical collisional value. During ohmic heating in the B stellarators, the diffusion coefficient was given by the Bohm formula. Quantitative evidence for the existence of intense ion waves in an ohmically heated plasma was obtained by spectroscopic measures of line profiles in B-65. A set of measurements on the propagation of ion cyclotron waves was completed in B-66. Machine development and engineering is also discussed. (M.C.G.)

2585 (MATT-Q-16) QUARTERLY REPORT COVERING THE PERIOD JULY 1–SEPTEMBER 30, 1961 [ON PROJECT MATTERHORN]. (Princeton Univ., N. J. Plasma Physics Lab.). Nov. 7, 1961. Contract AT(30-1)-1238. 34p.

The Model C stellarator was essentially completed and experimental operation begun. The intrinsic confinement time of the plasma in C, as evidenced by the rate at which the electron density decays during an ohmic heating pulse, appeared to be an order of magnitude longer than in B-3. A simple instability in the cesium plasma was isolated. When a current was passed through a thin filament along the axis of the plasma column, oscillations at a frequency 1.2 times the ion cyclotron frequency were observed, provided the electron drift velocity was greater than about 10 times the ion thermal velocity. A high-speed ion gage was developed and tested for the B-65. The anomalous direction of rotation of the ion cyclotron wave polarization vector for B-66 was studied. Some cross-correlations were measured between density and floating potential, floating potential and plasma current, and plasma current and density. A parametric study was made of the transmission of a short burst of plasma through a 90° sector of magnetic field. Spectra studies were also made. Equipment development was continued. Theoretical studies were continued. (M.C.G.)

2586 (NP-10905) WILLS PLASMA PHYSICS DEPARTMENT—SIX-MONTHLY PROGRESS REPORT, JANUARY 1–JULY 1, 1961. (Sydney. Univ. School of Physics). 6p.

A summary of activities is given which deals mainly with proposals for future work and efforts devoted to assembly of the necessary equipment. Included are discussions on developmental proposals for plasma sources, and design and construction of diagnostic equipment such as microwave interferometers, microwave noise meters, magnetic loops and spectral instrumentation. (J.R.D.)

2587 (NP-10987) WILLS PLASMA PHYSICS DEPARTMENT SIX-MONTHLY PROGRESS REPORT, JANUARY 1–JULY 1, 1961. C. N. Watson-Munro (Sydney. Univ. School of Physics). July 15, 1961. 6p.

Two plasma sources, SUPPER I and II, and various diagnostic equipment are described. (D.L.C.)

2588 (NYO-9761) THE EFFECT OF FINITE CONDUCTIVITY ON THE PROPAGATION OF HYDROMAGNETIC SLOW WAVES. Tosiya Taniuti (New York Univ., New York. Inst. of Mathematical Sciences). Sept. 15, 1961. Contract AT(30-1)-1480. 16p. (MF-21)

The one-dimensional propagation of disturbances in an inviscid conducting fluid of finite magnetic Reynolds number was investigated. The basic equations were not hyperbolic but, nevertheless, the slow wave had a domain of dependence determined by the sound velocity. (auth)

2589 (USCEC-83-208) MICROWAVE MEASUREMENTS OF PLASMA FLOW IN A SUPERSONIC WIND TUNNEL. Koichi Oshima (University of Southern California, Los Angeles. Engineering Center). Sept. 1961. Contract AF49(638)-831. 39p. (AFOSR-1556).

A 24 kilomegacycle microwave interferometer was used to measure the density and the collision frequency of electrons in a plasma flow in a small supersonic wind tunnel, which was heated by 13 megacycle radiofrequency power supply. First, by means of slabs and stips of known dielectric properties, the characteristics of microwave interaction with the tunnel filled with the dielectrics were examined, and it was confirmed that the measured phase shift agrees with the predicted one. Next, the results were obtained for a stable plasma flow, and they showed reasonable values. However, the unstable plasma flow, which usually occurred at high input power and at low pressures, could not be measured. (auth)

2590 (AEC-tr-4703) EVOLUTION DISCONTINUITIES IN MAGNETOHYDRODYNAMICS. A translation of "Evolyutsionnye Razryavy v Magnitnoi Gidrodinamike." A. I. Akhiezer, G. Ya. Lyubarskii, and R. V. Polovin (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 17p.

The conditions of evolutionarity of plane magnetohydrodynamic shock waves are treated in detail. It is shown that, if the total number of magnetoacoustic, Alfven, and entropy shock waves which diverge from the discontinuity front is not equal to six, the shock waves are non-evolutionary and should split into several shock and self-similar waves. (D.L.C.)

2591 (AEC-tr-4705) PRODUCTION OF PLASMA BY RADIAL COMPRESSION AND MEASUREMENT OF SOME OF ITS PARAMETERS. A translation of "Poluchenie Plazmy Metodom Radial'nogo Szhatiya i Izmerenie ee Nekotorykh Parametrov." M. D. Borisov, V. G. Zykov, I. A. Stepanenko, A. M. Ternopol, V. G. Padalka, and L. V. Brzhechko (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 18p.

In order to study the mechanism of energy losses in plasmas, a race-track apparatus was constructed for producing a highly ionized plasma without large electric fields. The means adopted for producing 10,000-gauss magnetic fields with a buildup time of 5 to 6 μsec and for producing 100% ionization are discussed. Some measurements of the plasmas are reported which indicate pulsation of the plasma in the radial direction. The plasma temperature was found to increase with increasing magnetic field. (D.L.C.)

2592 (AEC-tr-4706) PLASMA IN ALTERNATING MAGNETIC FIELD. A translation of "Plazma v Peremennom Magnitnom Pole." Ya. F. Volkov, Yu. S. Pavlov, V. T. Tolok, and A. I. Skibenko (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 12p.

A procedure is described for investigation of electrodeless discharges in alternating magnetic fields with mirror topography. Results are presented in high-speed photographs of discharge in H and Ar along with oscillograms and observations of oscillations in plasma pinches. (J.R.D.)

2593 (AEC-tr-4722) CONCERNING THE PROPAGATION OF A PLASMOID IN A MAGNETIC FIELD. A translation of "K Voprosy o Rasprostranenii Plazmennogo Sgustka v Magnitnom Pole." B. G. Safronov, V. P. Goncharenko, and D. K. Goncharenko (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 8p.

It was observed that a plasmoid injected tangentially in the field of a toroidal solenoid propagates not only in the direction of its initial velocity, but also in the opposite direction. Measurements were made of the velocity of propagation of a plasma introduced into a solenoid field. The results show that the velocity along the force lines increases and that perpendicular to the force lines decreases with increasing field. The phenomenon is explained with the help of an analogy using a conducting metal moved through a transverse magnetic field. (D.L.C.)

2594 (AEC-tr-4724) NONADIABATIC TRAPS FOR CHARGE PARTICLES. I. A translation of "Neadiabaticheskie Lovushki Zaryazhennykh Chastits." K. D. Sinel'nikov, B. N. Rutkevich, B. G. Safronov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 17p.

A discussion is given showing that it is possible to construct a nonadiabatic trap, the ideality, of which, is wholly determined by the exact parallelness of the particles entering the trap. An analysis was made of the case of nonadiabatic traps, in which the deviations from ideality are determined by deviations from monochromaticity of the velocities of the injected particles. (B.O.G.)

2595 (AEC-tr-4725) MAGNETIC MOMENT OF PLASMOIDS. A translation of "O Magnitnom Momente Plazmennykh Sgustkov." K. D. Sinel'nikov, B. G. Safronov, and N. V. Topolya (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 12p.

The magnetic properties of plasmoids moving in an inhomogeneous axially symmetrical magnetic field of up to 100 gauss were investigated with magnetic probes and a Rogowski belt. The results indicate that the plasmoid is deformed by its motion in the magnetic field gradient, and that the current loop or disc is compressed toward the axis and then propagated in a homogeneous field near the axis. (D.L.C.)

2596 (AEC-tr-4726) MOTION OF PLASMOIDS TRANSVERSELY TO A MAGNETIC FIELD. A translation of "Dvizhenie Plazmennykh Sgustkov Poperek Magnitnogo Polya." K. D. Sinel'nikov, B. G. Safronov, V. A. Sidorkin, and S. A. Trubchaninov (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 18p.

An investigation of processes involved in propagation of plasmoids in vacuum is described. Preliminary experiments showed that the motion of plasma in inhomogeneous magnetic fields is accompanied by polarization and a complicated drift. Experiments in which the effect of plasma polarization and drift were examined are reported. (J.R.D.)

2597 (AEC-tr-4729) INVESTIGATION OF MAGNETIC PROPERTIES OF A PLASMA BEHIND THE FRONT OF A STRONG SHOCK WAVE. A translation of "Izuchenie Magnitnykh Svoistv Plazmy za Frontom Sil'noi Udarnoi Volny." K. D. Sinel'nikov, B. G. Safronov, Yu. S. Azovskii, G. G. Aseev, and V. S. Voitsenya (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 18p.

Currents in a plasma were investigated behind the front of a strong shock wave, at Mach number M = 30 to 70, occurring in propagation of a shock in a magnetic field of ≃400 oersted. The nature of such currents is discussed for the case of homogeneous and inhomogeneous magnetic field. The dependence of the currents on the magnetic field and on the distance to the source of the shock wave in a homogeneous magnetic field is obtained. The applicability of the method for the determination of the conductivity and temperature behind the front of a strong shock wave, M > 20, is discussed. Magnetic signals have been detected from the plasma behind the shock wave, the nature of which is not fully clear. (auth)

2598 (AEC-tr-4731) MEASUREMENT OF THE DENSITY OF A PLASMA WITH THE AID OF A RESONANT CIRCUIT. A translation of "Ob Izmerenii Plotnosti Plazmy s Pomoshch'yu Kolebatel'nogo Kontura." N. G. Sinitsa (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 28p.

The problem on the propagation of an axially-symmetrical electromagnetic wave along a helix containing a plasma is solved in the linear hydrodynamic approximation. The problem is also considered for the shift of the resonant frequency and the change in resistance of the resonant circuit when the plasma is placed inside the inductance coil. The problem is considered for two cases: in the presence of a constant magnetic field and in its absence. In the former case, for the sake of simplicity, the losses in the plasma are neglected. (auth)

2599 (AEC-tr-4733) ON ADIABATIC VARIANTS FOR A PLASMA IN A MAGNETIC FIELD. A translation of "Ob Adiabaticheskikh Variantakh dlya Plazmy v Magnitnom Pole." Ya. B. Fainberg and V. I. Kurilko (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 8p.

The considerations for the adiabatic invariants of a plasma in a magnetic field are made for the cases where all the quantities change only along the constant field H_0, the quantities that remain invariant in the adiabatic variation of parameters of the system along the constant field, and the determination of the invariants for a plasma rod of radius $\underline{a}$. The temporal adiabatic invariants for the plasma were concluded not to coincide with the invariants for isolated ions and electrons, but tend to these values if the plasma density or the wave length tend to zero. The variations of the properties of plasma oscillations under adiabatic variation of the plasma parameters in the cases considered are discussed. (B.O.G.)

2600 (AEC-tr-4735) INVESTIGATION OF STABILITY OF CYLINDRICAL PLASMA PINCH. A translation of "Issledovanie Ustoichivosti Tsilindricheskogo Plazmennogo Shnura." V. I. Yashin (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 13p.

A criterion for the stability of a cylindrical plasma pinch is derived in the approximation of Chew, Goldberger, and Low. The perturbation for which the change in the potential energy of the system is calculated is one in which the magnetic force line helices are displaced as a whole without deformation. The resulting criterion is compared with that derived in the magnetohydrodynamic approximation by Suydam. (D.L.C.)

2601 (AEC-tr-4742) THEORY OF SIMPLE SHOCK [PLANE] WAVES. A translation of K Teorii Prostykh Voln. G. Ya. Lyubarskii and R. V. Polovin (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 6p.

A demonstration is given which shows that in magnetohydrodynamics a region of constant flow can be contiguous with a strong discontinuity or with a plane wave from considerations for the hyperbolic system of partial differential equations in the one-dimensional case. (B.O.G.)

2602 (AERE-Trans-872) MASS-SPECTROMETER STUDIES OF ION EMISSION AND ION DISTRIBUTION IN GAS DISCHARGE PLASMAS. O. Reifenschweiler. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from p.541-8 of Proc. Intern. Conf. Ionization Phenomena Gases, 4th, Uppsala, 1959. 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 17474.

2603 (CEA-tr-A-1019) ETUDE DE LA STABILITE D'UN PLASMA EN GRAVITATION DANS DES CHAMPS CROISES. (Investigation of Gravitational Stability of Plasma in Crossed Magnetic Fields). F. Meyer. Translated into French by P. Monnard from Z. Naturforsch., 13a: 1016-20(1958). 21p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 5472.

2604 (JPRS-10607) ON THE INSTABILITY OF A NON-HOMOGENEOUS RAREFIED PLASMA IN A POWERFUL MAGNETIC FIELD. L. I. Rudakov and R. Z. Sagdeev (Sagdeyev). Translated from Doklady Akad. Nauk S.S.S.R., 138: 581-3(1961). 5p.

A mechanism of instabilities in inhomogeneous rarefied plasmas in strong magnetic fields is proposed which does not involve a nonisothermic plasma state having a longitudinal electric current. The results are applied to the case of particles having Maxwellian velocity distributions. (D.L.C.)

2605 (NP-tr-814) TYPES OF MOTION IN THE LINEAR PINCH EFFECT AND RUNAWAY ELECTRONS. E. Fuenfer, G. Lehner, and H. Tuczek. Translated by S. M. Pugh (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. Naturforsch., 15a: 566-74(1960). 27p.

Using a simplified model, the time dependence of plasma radius and current in the case of the linear stabilized pinch is calculated and compared with experiment. The results give information on the induced azimuthal electric field strengths which provide an explanation for the x rays observed in the experiments. (auth)

2606 (SCL-T-377) THE PROPAGATION OF SUCCESSIVE SHOCK WAVES. A translation of "Rasprostranenie Posledovatel'nykh Udarnykh Voln." B. G. Safronov, G. G. Aseev, and Yu. S. Azovskii (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 25p.

The origin and propagation of shock waves were studied during a vibrating and damped (fading) discharge in hydrogen, air, and argon. Successive shock waves were observed which corresponded to semi-periods of the discharge current. Shock waves with Mach numbers up to 80 were obtained. The results for the first shock wave were compared with the theoretical functions. The difference between the propagation of the first wave and that of subsequent waves is explained qualitatively. (auth)

2607 EXCITATION OF ACOUSTIC WAVES BY INTERACTION BETWEEN THE CHARGED PARTICLES AND THE NEUTRAL MOLECULES IN A DISCHARGE TUBE. Jacques Briand, Jean-Loup Delcroix, and Maria-Luiza Fanzeres de Castro Fernandes. Compt. rend., 253: 824-6 (July 31, 1961). (In French)

A description is given of an experiment on the excitation of acoustic waves by electron-molecule interaction in a discharge tube. If in a weakly ionized gas an electric field is applied, the movement of electrons and ions under the effect of this field is essentially curbed by the collisions of these particles with the neutral molecules of the gas. It can then be expected that this exchange of quantities of movement causes finally acoustic waves. (tr-auth)

2608 EFFECT OF THE ELECTRIC FIELD ON THE PROPAGATION OF WAVES IN A PLASMA. Pierre Bertrand and Georges Briffod. Compt. rend., 253: 827-8 (July 31, 1961). (In French)

If in a plasma the distribution of particle velocities is not isotropic, there is produced a coupling between the longitudinal, electrostatic, and electromagnetic oscillations. These coupling terms are explained for a plasma exposed to the action of perpendicular magnetic and electric fields. (tr-auth)

2609 PLASMA POTENTIAL IN A MAGNETIC MIRROR SYSTEM. D. J. BenDaniel (Univ. of California, Livermore). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 235-41(Oct. 1961). (In English)

An estimate is made of the plasma potential created by the more rapid initial loss of electrons from magnetic mirror confinement. The effects of this potential on the mirror ratio of the system is discussed. Calculations of this potential as a function of position in the magnetic mirror system are presented for two cases of interest. (auth)

2610 EQUILIBRIUM CONFIGURATION OF THE PLASMA IN THETA DISCHARGES WITH REVERSED TRAPPED MAGNETIC FIELDS. J. K. Wright, R. D. Medford, and B. Chambers (Atomic Weapons Research Establishment, Foulness, Essex, Eng.). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 242-5(Oct. 1961). (In English)

The equilibrium state of a long tubular plasma with reversed trapped magnetic fields is discussed. It is shown that an equilibrium position stable to longitudinal perturbations exists for each value of the ratio of external to trapped flux providing the cross-sectional area of the plasma is less than half the total area of the system. Variations in the containing magnetic field give rise to variations in the length and the cross-sectional area of the plasma tube. With observations confined to the end-view of the plasma and assuming that the tube did not vary in length, the observed variation in cross-sectional area would lead one to an assumption of an apparent value of $\gamma = 4$ for the plasma. (auth)

2611 THE HYPOTHESIS OF SCALAR PRESSURE IN THE DYNAMICS OF COLLISIONLESS PLASMAS. P. H. Rebut and J. P. Somon (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research, 3: 246-55(Oct. 1961). (In French)

The validity of the assumption of a scalar pressure is studied for a collisionless plasma, assuming the isotropy of the velocity distribution functions around a mean velocity. The exact solution of the system of equations formed by the collisionless Boltzmann's equation and the Maxwell's equations is investigated in a consistent non-relativistic approximation. Dynamical solutions are found to be impossible. The helical static pinch considered in a previous work is the only case. The magnetohydrodynamical assumptions of scalar pressure, state equation, without heat transport lead to the same result. (auth)

2612 ENERGY ABSORPTION IN A LONGITUDINAL WAVE IN A COLLISIONLESS, MAGNETIZED PLASMA.

A. Kildal (Univ. of Bergen, Norway). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 256-60(Oct. 1961). (In English)

Calculations are made of the energy absorption in a longitudinal plasma wave. The direction of propagation is arbitrary with respect to an external magnetic field H_0. Electrons experiencing a constant electric field are responsible for the absorption. In the non-magnetic case these electrons have a velocity equal to the wave's phase velocity. On the assumption that the absorbed energy is extracted from the wavefield, a damping factor is calculated. When this factor is evaluated for the same cases as studied previously by other authors, complete agreement is found. This damping is called Landau damping. (auth)

2613 STABILITY OF THE HARD-CORE LIQUID MODEL OF THE PINCH. J. N. Tandon and S. P. Talwar (Delhi Univ.). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 261-5(Oct. 1961). (In English)

A theoretical investigation for the sausage instability of a hard-core mercury jet is made. It is found that a parallel current system in the core and the jet has a destabilizing influence and antiparallel current improves the stability of the configuration. For a configuration characterized by the same current density in the jet and the core, the maximum growth rate is smaller than the corresponding growth rate for a homogeneous liquid jet without a core. (auth)

2614 IMPURITY RADIATION LOSSES FROM A HIGH TEMPERATURE PLASMA. R. F. Post (Univ. of California, Livermore). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 273-86(Oct. 1961). (In English)

Enhanced radiation losses from a hydrogen-plasma containing a small percentage, particle-wise, of high Z impurities are discussed. Because the intrinsic radiation rate per atom from impurities can be many orders of magnitude greater than the Bremsstrahlung radiation from ionized hydrogen, even a small fractional impurity content can greatly increase the total escaping radiation flux. (auth)

2615 MAGNETIC CONFIGURATIONS AND THE ENERGY LOSS PROBLEM IN THE TOROIDAL PINCHED DISCHARGE. N. L. Allen (Associated Electrical Industries, Ltd. Research Lab., Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 293-5(Oct. 1961). (In English)

A study is made of the elucidation of energy loss processes in the toroidal pinched discharge. The study is accomplished by making magnetic probe measurements of the torus walls in order to determine the magnetic field irregularities at various points along the discharge column. Results of measurements in Sceptre III show that the magnetic configurations of the azimuthal and axial components of field are generally similar. The experiment shows that geometrical irregularities are unimportant in producing a current drain to the walls of a magnitude resolvable by the probe technique. Plots are given of the azimuthal and axial fields showing the existence of a fairly uniformly conducting, contracted current channel. (N.W.R.)

2616 OBSERVATIONS WITH A SMALL THETA-PINCH. M. J. Gross and W. Millar (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C, Plasma Phys.-Accelerators-Thermonuclear Research, 3: 295-6(Oct. 1961). (In English)

Oscillograms are given of the observations made with a small theta-pinch device having the following parameters: peak magnetic field on axis (80 kG), period of oscillation of the field (2.5 microsecond), and capacity energy (1.3 kj at 20 kv). Results show that in the absence of a pre-ionizing field, breakdown of the gas occurs. Thus it is believed that high-frequency parasitic oscillations in the main current circuit play an important role in the breakdown process. Typical phenomena in deuterium and helium discharges are illustrated by oscillograms from sodium iodide and stilbene scintillators placed a few inches from the discharge tubes. Other properties which effect oscillations are also discussed. (N.W.R.)

2617 PLASMA DRIFT VELOCITY ACROSS A CONFINING MAGNETIC FIELD. S. Miyajima (Nagoya Univ., Japan), S. Ito, and P. C. Thonemann. Proc. Phys. Soc. (London), 78: 618-20(Oct. 1, 1961).

The steady drift velocity of fully ionized plasma across a confining magnetic field is usually given as $\nu = -\eta/B^2\, \Delta p$, where η is the electrical resistivity and B is a steady magnetic field normal to the pressure gradient ∇p. This is derived from the equation of plasma motion by neglecting the inertia term $(\nu \cdot \nabla)\nu$. It is shown, however, that this term cannot be neglected if the plasma is bounded by a material wall. This does not imply that a plasma cannot be confined by a magnetic field. It is sound that the velocity of plasma drift transverse to a magnetic field is correctly given by the above equation for $\nu^2 \ll c^2$, whereas for a bounded plasma, the upper limit is close to $[k(T_e + T_i)m_i]^{1/2}$ independent of the magnetic field strength. (L.N.N.)

2618 IMPROVEMENTS IN OR RELATING TO PARTICLE CONFINING DEVICES. (to Compagnie Generale de Telegraphie Sans Fil). British Patent 881,559. Nov. 8, 1961.

A charged particle confinement device of the magnetic mirror type is designed in which losses through "plugs" are reduced. The device includes an evacuated vessel, means for injecting ions and electrons into the vessel, and means for producing a magnetic field along the longitudinal axis of the vessel and having a region of minimum strength between regions of maximum strength. The vessel comprises two portions in communication with each other through a cavity resonator in which uhf electromagnetic oscillations are induced. (D.L.C.)

2619 PLASMA DEVICE. (to U. S. Atomic Energy Commission). British Patent 881,786. Nov. 8, 1961.

A plasma device is designed for producing a high-energy plasma as a source of charged particles and neutrons. The device comprises a chamber into which a gas is fed from an axial anode. An axial magnetic field and a radial electric field are set up, forming about the anode an electron sheath which functions as an efficient ionizing and plasma heating agent. The magnetic field increases toward the chamber ends to form a magnetic mirror for plasma confinement. (D.L.C.)

Shielding

2620 (NASA-TN-D-850) MONTE CARLO STUDIES OF GAMMA-RAY AND NEUTRON TRANSPORT IN INFINITE HOMOGENEOUS MEDIA. Theodore E. Fessler and Millard L. Wohl (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Nov. 1961. 50p.

Two Monte Carlo codes were written for the IBM 704 computer. One simulates gamma transport from a monoenergetic point source in an infinite medium; the second is a similar code for neutron transport. Statistical variance reduction techniques designed for use in the codes allowed the calculation of more accurate values of gamma and neutron deep-penetration number and energy spectra than would be possible in a straightforward Monte Carlo calculation. A form of exponential importance sampling was used to emphasize long particle transit distances and small polar scattering angles, thus favoring deeply penetrating particles. Studies were made of gamma energy spectra and buildup factors for 1-Mev-source gamma rays in water and 6-Mev-source gamma rays in tin at various penetration depths. These calculations were done both with and without inclusion of the importance sampling. Comparisons were made with moments-method solutions for the same problems; the agreement was good at shallow penetrations in both cases. In addition, deep penetration results, at 7 and 10 source energy relaxation lengths, obtained by importance sampling also agreed well with moments-method solutions. A low-energy spectral peak was observed in the Monte Carlo calculation for the case of 6-Mev gamma rays in tin; this is due to gamma rays from pair-production positron annihilation and is not present in the moments-method results, which do not include the effects of pair production. Calculations of neutron number spectra for 6-Mev-source neutrons at various penetration depths in water showed good agreement with moments-method results. Importance sampling became necessary to produce reasonable agreement at penetration distances greater than 30 centimeters. Monte Carlo results were reliable to as deep a penetration as 90 centimeters, or 12 source energy mean free paths. (auth)

2621 (RFP-245) CRITICALITY MEASUREMENTS PERFORMED IN SITU. C. L. Schuske (Dow Chemical Co. Rocky Flats Plant, Denver). 1961. Contract AT(29-1)-1106. 17p.

Low level neutron multiplication measurements made in situ are being used as an aid in arriving at safe, practical criticality limits for design and operation of process equipment handling U^{235}, Pu^{239}, and U^{233}. (auth)

2622 (RFP-246) NUCLEAR SAFETY MEASUREMENTS ON SYSTEMS CONTAINING BORON AND ENRICHED URANIUM. C. L. Schuske and G. H. Bidinger (Dow Chemical Co. Rocky Flats Plant, Denver). 1961. Contract AT(29-1)-1106. 23p.

Neutron multiplication measurements were made on two types of enriched uranium systems containing boron as a nuclear poison. They were: a 36-in. diameter partially tamped tank containing spaced vertical boron-stainless steel plates and tamped and untamped assemblies of $UO_2(NO_3)_2$ salts at low hydrogen moderation containing Pyrex Raschig rings. Attempts were made to calculate sphere masses and infinite cylinder and slab shapes from the experimental data. (auth)

2623 SPATIAL DISTRIBUTION OF FAST NEUTRONS IN IRON. V. P. Mashkovich and S. G. Tsypin. Atomnaya Energ., 11: 251-5(Sept. 1961). (In Russian)

Iron is one of the most suitable, cheapest and the most widely used shielding materials but the neutron flux distribution in it is not sufficiently well known. This problem was studied experimentally in the BR-5 reactor. The spectrum of neutrons incident on the shield under study was determined by means of a 200-micron thick emulsion. Comparison with the fission spectrum showed that at energies below 3 Mev the spectrum is somewhat softened. The prism used for the measurements consisted of perforated bundled iron layers containing the detector. As fast neutron detectors $S^{32}(n,p)P^{32}$, and $Al^{27}(n,\alpha)Na^{24}$ threshold indicators were used. The activities of the indicators as a function of the distance were thus determined. A Th^{232} fission chamber and a threshold indicator $Mg^{24}(n,p)Na^{24}$ were used for energies of about 2 and 5 Mev. The asymptotic cross section data calculated from diffusion length values agree quite well with those obtained on the basis of the determination of the relaxation length: $\sigma_{Mg}24 = 1.87$ barn and $\sigma_{Al}27 = 1.87$ barn. (TTT)

2624 IMPROVEMENTS RELATING TO RADIATION SHIELDING FOR NUCLEAR EQUIPMENT. Brian Frederick Cooke (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 882,031. Nov. 8, 1961.

A reactor shielding of the multilayer type is designed which can be used at high temperatures where separation of boron and bitumen mixtures is likely to occur. The shielding comprises a gamma absorbent layer nearest the source of radiation, a thermal neutron absorbent layer, a fast neutron absorbent layer, and finally a gamma absorbent layer. The layers may be made out of lead, boron-containing material, unborated bitumen, and lead, respectively. (D.L.C.)

Theoretical Physics

2625 (AFOSR-1176) SIMPLIFICATION OF THE TWO-BODY UNITARITY RELATION. Marcel Froissart (California. Univ., Berkeley). [1961]. Contract AF49(638)-327. 14p.

A reduction is obtained in the number of integrations needed to compute the scattering amplitude from a potential by dispersion-theoretical methods. (auth)

2626 (JINR-E-775) PROPERTIES OF THE SOLUTION OF THE EQUATION FOR ONE MODEL OF THE LOCAL FIELD THEORY. B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 10p.

The solution of the low equation for the scattering amplitude of scalar mesons on a fixed nucleon which can be in two states different in mass was investigated. It was found that for the energies $\omega < 2\mu$ contributions of many-particle states to the scattering amplitude are not essential. The connection of the resonance solution with the nonphysical pole of the amplitude is considered. (auth)

2627 (WIS-AEC-31) HYPERVIRIAL THEOREMS APPLIED TO MOLECULAR QUANTUM MECHANICS. Joseph O. Hirschfelder (Wisconsin. Univ., Madison. Theoretical Chemistry Lab.) and C. A. Coulson (Oxford Univ. Mathematical Inst.). Oct. 2, 1961. Contract AT(11-1)-298. 20p.

Previous discussions of hypervirial theorems in wave mechanics were extended in three ways. A particular class of operators, called compound hypervirial operators, was introduced, and the particular point transformations which they may be said to generate, were studied. An example of these new operators is an electron-correlation hypervirial, which modifies a wave function when two electrons are near together, but exerts little influence when they are a long way apart. A study was made of possible wave functions for a diatomic molecule which satisfy the Hellmann-Feynman theorem and provide a means of deducing the shape of the potential energy curve, or its slope at a particular internuclear distance. (auth)

2628 THE THEORY OF NUCLEAR MATTER. J. S. Bell (CERN, Geneva) and E. J. Squires. Advances in Phys., 10: 211-312(July 1961).

An account of the present position of nuclear matter theories, mainly initiated by Jastrow and Brueckner, is presented. Basic ideas are introduced, and the variational approach is discussed. Methods, difficulties, and partial resolution of the difficulties using ideas from superconductivity theory are analyzed. Relevance to the nuclear matter ground state was used as a criterion in the selection of material. (L.N.N.)

2629 A SOLUBLE MODEL IN QUANTUM FIELD THEORY: THE WENTZEL MODEL. Guy Rideau (Institut Henri Poincaré, [Paris]). Ann. inst. Henri Poincaré, 17: 91-128(1961). (In French)

The explicit forms of the proper vectors of the Wentzel model are found for all possible cases. The structure corresponding to the Hilbert space, as well as the method for obtaining the physical creation and annihilation operators, is studied for each of these cases. It is shown that, in the presence of a bound state (i.e., a "pathological" state), there exists no canonical transformation relating the free annihilation and creation operators to the physical annihilation and creation operators. (tr-auth)

2630 ON THE INTEGRAL FORM OF THE EQUATION OF EVOLUTION OF A PHYSICAL SYSTEM AND ITS SOLUTIONS. Roland Guy (Univ. of Montreal). Ann. inst. Henri Poincaré, 17: 129-48(1961). (In French)

By analogy with an actual case, a very general form may be obtained for the equation of evolution of a physical system. This analogy is rigorously validated. To this end, the ensemble L(B) of endomorphisms of a full Banach space B, which forms a closed ring, is considered. Further, the ensemble C_s of the functions defined over the interval [a,b] of R, with values over L(B), is found to have the property that the normal to L(B) may be considered to be an L(B)-modulus, topologically left-handed. A limited study of the linear properties of C_s over L(B) generalizes the classical problem to the form of a problem concerning functionals over a given functional space. It is shown that the problem's solution is in the form of a Steltjes-Riemann integral. The Banach space is restricted to be a full Hilbert space $\mathcal{H}$, to allow a study of the solutions to the Visconti equation. This equation is a vectorial integral equation over $\mathcal{H}$ with an unbounded kernel. Liberal conditions are found for the existence of a solution, by a method similar to the method of successive approximations. The existence theorem is applied to a study of the Caunchy problem, of a homogeneous differential equation over a Hilbert space having an unbounded kernel. (tr-auth)

2631 STATIC ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. PART III. Bidyut Kumar Datta (Surendra Nath Coll., Calcutta). Ann. Phys. (N. Y.), 15: 403-10(Sept. 1961).

The equations of the "already unified theory" as given by Raychaudhuri for static electromagnetic fields are considered for the case in which the diagonalized metric tensor components are functions of two coordinates only. Special solutions are obtained and the nonexistence of some types of solutions is demonstrated. (auth)

2632 A NOTE ON PROPER ANGULAR MOMENTUM VARIABLES AND THE IMPLICATION FOR ANGULAR CORRELATION THEORY. L. C. Biedenharn and P. J. Brussaard (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 16: 1-13(Oct. 1961).

Although angular momentum theory in quantum mechanics has been extensively investigated, the uncertainty relations for the angular momentum variables do not seem to be considered in equal detail. This problem is studied. It is shown that the factorization of the angular correlation coefficients in the Legendre expansion for a two-step nuclear reaction involving a pure intermediate state, is a direct consequence of the uncertainty relations. (auth)

2633 ON FIELD THEORIES WITH DEGENERATE GROUND STATES. K. Baumann, G. Eder, R. Sexl, and W. Thirring (Universität, Vienna). Ann. Phys. (N. Y.), 16: 14-25(Oct. 1961).

A model field theory of the superconducting type is solved exactly. The exact solution is compared with the Bardeen–Cooper–Schrieffer solution. The exact ground state is nondegenerate while the Bardeen–Cooper–Schrieffer ground state is degenerate. The connection between the two types of ground states, and between their energies, is given. Also some properties of the excited states are discussed. (auth)

2634 THE LEFT-HAND CUT AND PHASE-EQUIVALENT POTENTIALS. M. Fowler (St. John's Coll., Cambridge, Eng.). Ann. Phys. (N. Y.), 16: 26-35(Oct. 1961).

The expected correspondence between the discontinuity across the left-hand cut and the potential does not appear to hold for some potentials which Bargmann showed to have identical left-hand singularities but vary widely in form and in asymptotic behavior. The potentials have one bound state at a given energy. The apparent contradiction is resolved by a consideration of the physical structure of the left-hand singularities in Bargmann's model. (auth)

2635 VARIATIONAL CALCULATIONS OF SCATTERING. Charles Schwartz (Univ. of California, Berkeley). Ann. Phys. (N. Y.), 16: 36-50(Oct. 1961).

It was found that the behavior of calculated results using variational principles for scattering problems is different from that previously known for the bound-state problems. As more and more adjustable terms are added to the trial function, the "stationary" value for the phase shift does not converge smoothly, but may on occasion turn out to be grossly inaccurate. The phenomenon is displayed and partially analyzed, but not completely understood. It is concluded that for a given amount of computational labor, a scattering phase shift may be determined only to an accuracy an order of magnitude worse than that of the analogous eigenvalue problem. (auth)

2636 AN ALTERNATIVE APPROACH TO THE THEORY OF GRAVIATION. Walter E. Thirring (Universität, Vienna). Ann. Phys. (N. Y.), 16: 96-117(Oct. 1961).

In constructing a theory of gravitation using a massless tensor field and observing all axioms of field theory many similarities to electrodynamics are met. The field equations require a conserved source and admit a gauge-group. However, the equations of motion of particles are gauge invariant only if the gauge transformation of the field is supplemented by a linear coordinate transformation. As a consequence the original pseudo-Euclidean metric is gauge-variant and therefore unobservable. A gauge-invariant metric is defined by investigating the effect of the gravitational potential on real measuring rods and clocks. This "renormalized" metric which is directly defined by observable quantities agrees with the Riemannian metric of Einstein's general relativity. Selecting a certain gauge by boundary conditions, Newton's theory in first approximation is obtained. In this "unrenormalized" picture the effect of a gravitational potential is to change the effective charge and mass of particles, rather than the metric. The presence of other masses decreases the charge and increases the mass in agreement with Mach's principle. The three observable effects of general relativity can be easily understood in both the renormalized and the unrenormalized pictures provided they are carefully kept apart. (auth)

2637 AN INTRODUCTION TO THE GENERAL THEORY OF RELATIVITY. F. R. Tangherilini (Scoula di Perfezionamento in Fisica Teorica e Nucleare, Naples). Nuovo cimento (10), 20: Suppl. No. 1, 1-86(1961). (In English)

Fundamental aspects of general relativity are considered, with special emphasis on cosmological problems. Points of disagreement between special and general relativity are discussed. Subjects investigated include rotating coordinate systems, the equivalence principle, tensor analysis, Riemannian geometry, the Schwarzschild and Einstein fields, and Mach's principle. (T.F.H.)

2638 CANONICAL VARIABLES IN RELATIVISTIC QUANTUM THEORY. K. Bardakci and R. Acharya (Univ. of Rochester, N. Y.). Nuovo cimento (10), 21: 802-10 (Sept. 1, 1961). (NYO-9363). (In English)

A simple general method is presented for the explicit determination of the operator corresponding to position in any relativistic one-particle theory. (auth)

2639 EXPERIMENTAL TESTS OF MACH'S PRINCIPLE. R. H. Dicke (Princeton Univ., N. J.). Phys. Rev. Letters, 7: 359-60(Nov. 1, 1961). (PUC-1961-43)

It is shown that the precise null results of previous experiments (Hughes, V. W., et al., Phys. Rev. Letters 4, 342(1960); Drever, R. W. P., Phil. Mag. 6, 683(1961)) are to be expected, resulting from an application of Mach's principle. It is demonstrated with precision that the anisotropy of the inertial mass is universal, the same for all particles. (L.N.N.)

2640 FIXATION OF PHYSICAL SPACE-TIME COORDINATES AND EQUATION OF MOTION OF TWO-BODY PROBLEM. Toshiei Kimura (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 26: 157-72(Aug. 1961). (In English)

The consistency of the canonical reduction of gravitational field coupled with point particles is investigated. It is shown that the Hamiltonian, obtained by eliminating constraints and imposing coordinate condition, gives exactly the same equations of motion as obtained by Einstein, Infeld, and Hoffman. Furthermore, the derivation of the approximate (up to the fourth order of velocity of particle) equation of motion is presented without tedious calculation. (auth)

2641 ANOTHER POSSIBLE MODEL OF QUANTUM FIELD THEORY WITH INDEFINITE METRIC. Kan-ichi Yokoyama (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 26: 272-3(Aug. 1961). (In English)

A convergent model of the unitary S matrix for the case in which a physical neutral scalar field A(x) with mass μ and a physical neutral scalar field $\psi(x)$ with mass κ interact with each other indirectly by way of four kinds of unphysical spinor fields, $\phi_1(x)$, $\phi_2(x)$, $\phi'_1(x)$, and $\phi'_2(x)$, is proposed. It is shown that there exists another possible model equivalent to the case of the extended vertex. Results obtained using the total Lagrangian are reported. (L.N.N.)

2642 CINEMATICA DEL ELECTRON RELATIVISTA. (Cinematics of Relativistic Electrons). Mario A. Bunge. Publication No. 34. Tucuman, Argentina, Universidad Nacional, 1960. 254p.

An investigation was made of the behavior of the electron velocity in relativistic quantum theory to contribute to the image of atomic physics. The investigations were conducted for the free movement of the electron and the movement of the central field with its continuous and discrete spectra, as well as the transitions between one and the other. The hypercomplex autofunctions were used, which are those that better permit the establishment of necessary physical significance of the various transition elements of a given magnitude, and which point out the corresponding elements to the inversion processes of spin and virtual modification of the charge. The physical significance of the matrix elements generated for the Dirac operators in the hypercomplex autofunction space is indicated. Calculations are made of the matrix elements of the distinct components of velocity in polar co-ordinates, referring to the free state and to the continuous and discrete spectra of the Coulomb field. Solutions of the original problems of integration are included. (B.O.G.)

2643 THÉORIE RELATIVISTE DES FLUIDES A SPIN. RECHERCHES SUR LA DYNAMIQUE DU CORPUSCLE TOURNANT RELATIVISTE ET L'HYDRODYNAMIQUE RELATIVISTE DES FLUIDES DOTÉS D'UNE DENSITÉ DE MOMENT ANGULAIRE INTERNE. (Relativistic Theory of Fluids with Spin. Research on the Dynamics of Relativistic Hydrodynamics of Fluids Having a Density of Internal Angular Momentum). Francis Halbwachs. Les Grands Problems des Sciences. X. Paris, Gauthier-Villars, 1960. 302p.

Quantum mechanical hydrodynamic representations and models are discussed. The statistical theorem of Bohm and Vigier is outlined. The "classical" theory of a relativistic spinning particle is described, from the standpoints of the theories of Frenkel, Mathisson, and Weyssenhoff. The general theory of a relativistic spinning particle is then elaborated. Several special cases of particle motion are considered. The theory behind hydrodynamic models for relativistic fluids having internal angular momentum is examined. Fluids having molecular structure as well as spin are investigated. (T.F.H.)

2644 LECTURES ON FIELD THEORY AND THE MANY-BODY PROBLEM. E. R. Caianiello, ed. New York, Academic Press Inc., 1961. 337p. $9.50.

Twenty three lectures are presented from the First International Spring School of Physics, held at the University of Naples in 1961. Separate abstracts have been prepared for 21 of the 23 papers included in the proceedings. Two of the papers have been previously abstracted in NSA. (T.F.H.)

2645 TCP THEOREM AND RELATED PROBLEMS. G. Lüders (Max-Planck-Institut für Physik und Astrophysik, Munich). p.1-26 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The relations between Bose-Einstein and Fermi-Dirac statistics in quantized field theory are studied. The TCP theorem is proved, using an antilinear operator to achieve the T, C, and P transformations. The occurrences and properties of particle-antiparticle pairs are studied, in the light of the TCP theorem and the existence of generalized charge (electric, baryonic, and leptonic). (T.F.H.)

2646 UNSTABLE PARTICLES AND COMPLEX POLES OF THE PROPAGATORS. B. Zumino (New York Univ., New York). p.37-45 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

A field theoretical study is made of unstable particles, making use of the complex poles—of the propagator or of the resolvent operator—in the second sheet of the energy variable. The properties and singularities of the resolvent operator are examined. The effects of complex poles on exponential decay are clarified. An expression is derived for transition amplitudes in terms of the complex poles. (T.F.H.)

2647 THE ASYMPTOTIC CONDITION AND DISPERSION RELATIONS. K. Symanzik (Max-Planck-Institut für Physik und Astrophysik, Munich). p.67-96 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

Methods for deriving the asymptotic condition in field theory are described. Matrix reduction techniques are also discussed. From the asymptotic condition, dispersion relations are derived. The properties and limitations of these relations are described. The dispersion relations are interpreted physically, and their high energy behavior is studied. The analyticity of the dispersion relations is examined. (T.F.H.)

2648 APPLICATION OF DISPERSION RELATIONS TO THE DETERMINATION OF COUPLING CONSTANTS. M. Cini (Università, Rome). p.97-111 "Lectures on Field Theory and the Many-Body Problems." New York, Academic Press Inc., 1961.

The use of the nucleon-nucleon scattering dispersion relations as a means for determining the nucleon-nucleon coupling constant is discussed. The effects of poles in the scattering amplitude are outlined. It is shown that the longest range nuclear forces are of the one-pion-exchange type. (T.F.H.)

2649 SECOND QUANTIZATION AND CONFIGURATION SPACE METHOD. J. G. Valatin (The University, Birmingham, Eng.). p.113-22 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The relation between two methods for describing quantum mechanical systems, viz. the methods of configuration space and second quantization, is discussed. Only non-relativistic systems of fermions are considered. Investigations are carried out on wave functions, state vectors, linear operators, one- and two-particle operators, and field quantities and equations. (T.F.H.)

2650 REGULARIZATION AND RENORMALIZATION. R. E. Caianiello (Università, Naples). p.123-6 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

Methods are discussed whereby certain divergencies (e.g., ultraviolet) may be avoided. These "regularization" methods may be used on any renormalizable field theory. (T.F.H.)

2651 PROPERTIES OF WIGHTMAN FUNCTIONS. Res Jost (Eidgenössische Technische Hochschule, Zurich). p.127-45 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The Wightman functions completely characterize a field theory, in terms of the vacuum expectation values of products of field operators. The effects of translational and Lorentz invariance on these functions are described. Analyticity properties of the functions are studied. Other characteristics of these functions are outlined. (T.F.H.)

2652 ANALYTICITY OF VACUUM EXPECTATION VALUES. J. Toll (Inst. of Theoretical Physics, Lund, Sweden). p.147-62 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

For the (N + 1)-point Wightman function, i.e., the vacuum expectation value for a product of (N + 1) local field operators, the analyticity properties are studied over the domain M_N for N = 1, 2, and 3. Basic concepts in the study of domains of holomorphy in several complex variables are reviewed. The boundary of M_3 is studied, and is found to contain a non-analytic hypersurface. (T.F.H.)

2653 CONNECTION BETWEEN WIGHTMAN FUNCTIONS AND r-FUNCTIONS. O. Steinmann (Eidgenössische Technische Hochschule, Zurich). p.163-72 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

A field theory satisfying Lorentz invariance, vacuum existence, and locality (for simplicity a single scalar field) is considered. The relation for the Wightman functions W (i.e., the vacuum expectation values of the products of the local field operators) and the r-functions (i.e., the vacuum expectation values of the retarded operators) is examined, in the case in which W and r are four-point functions. (T.F.H.)

2654 A NOTE ON THE TRANSFORMATION $\psi' = \exp[i\gamma_5\alpha]\,\psi$. B. Touschek (Università, Rome). p.173-82 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

It is shown that in a field theory of the Heisenberg type no simple particles of spin ½ and mass $\neq 0$ can exist. The case of degenerate (non-simple) particles is also considered. A necessary condition is found for the existence of massive spin ½ particles, as a consequence of the transformation $\psi' = \exp[i\gamma_5\alpha]\,\psi$. (T.F.H.)

2655 PAIS DOUBLETS AND WEAK INTERACTIONS. J. C. Polkinghorne (Univ. of Cambridge, Eng.). p.183-7 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

It is shown that the assumption of $\Delta I = ½$ (I is isotopic spin) for strangeness-violating weak interactions is in considerable disagreement with experiment. The introduction of Pais doublets, composed of Σ-Λ combinations, is found to give results compatible with experiment for this type of interaction, if the doublets are allowed to contain unequal distributions of Σ and Λ. (T.F.H.)

2656 TIME REVERSAL IN NUCLEAR FORCES. E. Henley (CERN, Geneva). p.189-97 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

Time reversal invariance is studied in nuclear reactions with and without polarization, in β decay, and in the correlations between successive radiations. (T.F.H.)

2657 ON SYMMETRY OPERATIONS IN QUANTUM MECHANICS. R. Hagedorn (CERN, Geneva). p.199-209 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

It is shown that, up to a unimodular factor, every possible symmetry operation in quantum mechanics can be represented in Hilbert space by either unitary or anti-unitary operators. To this end, rays, unit rays, and states of a quantum mechanical system are defined. Symmetry operations are defined in physical terms. Transformations in Hilbert space are studied. (T.F.H.)

2658 REMARKS ON THE NUCLEON FORM FACTORS IN THE CONFIGURATION SPACE. B. Bosco and V. De Alfaro (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). p.211-15 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

Using a spectral representation for the nucleon electromagnetic form factors, an investigation is made of the distributions of charge and magnetic moment in the configuration space. A necessary asymptotical condition is found that the configuration space distributions must fulfill. In addition, it is shown that experimental data can be obtained that yield direct information about the threshold behavior of the spectral functions. In the vector case, this behavior is related to the pion-nucleon scattering amplitude in the non-physical region. (T.F.H.)

2659 GLOBAL SYMMETRY OF THE ELEMENTARY PARTICLES. S. Nakamura (Istituto de Fisica Teorica Nucleare, Naples). p.217-28 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The "diatomic-molecular" model of elementary particles is considered. In this model the fermion is assumed to be composed of an isoscalar spinor massless "screwon" plus a kernel part, and the boson is two "screwons" plus a kernel. The mass multiplet characteristics in this model are outlined. The fundamental results of the model are reviewed. The model is used to analyze β decay. (T.F.H.)

2660 GROUND STATE THEORY OF MANY-PARTICLE SYSTEMS. L. Van Hove (The University, Utrecht). p.229-40 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

A perturbation approach to the ground state theory of a many-body system is discussed, using the Fermi gas as an example. In the determination of energy and wave functions of the perturbed ground state, diagram techniques analogous to those used in field theory are employed. (T.F.H.)

2661 ON THE MANY BODY PROBLEM AT NON-ZERO TEMPERATURE. C. Bloch (Centre d'Etudes Nuclêaires, Saclay, France). p.241-65 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The extension of the Feynman diagram and perturbation theoretical techniques of field theory to quantum statistical mechanics is studied. Methods for calculating the grand partition function of a statistical mechanical system by these field theoretical techniques are investigated. Attention is given to shield potentials and binary collisions. (T.F.H.)

2662 COLLECTIVE BEHAVIOUR OF A BOSON SYSTEM. J. G. Valatin (The University, Birmingham, Eng.). p.267-73 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The low-temperature collective solutions of boson systems with a predominantly repulsive interaction are found. The importance of condensation of a large number of particles into a single state (Bose-Einstein condensation) is discussed. The temperature dependence of the behavior of the system is examined. (T.F.H.)

2663 THE THEORY OF SUPERCONDUCTIVITY. J. G. Valatin (The University, Birmingham, Eng.). p.275-84 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The Bardeen-Cooper-Schrieffer theory of superconductivity is reviewed, in which superconductivity is attributed to an attractive two-body force between electrons that dominates the repulsive screened Coulomb interaction. (T.F.H.)

2664 THE POLARON MODEL. G. Höhler (Universität, Munich). p.285-304 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

The polaron model for describing electron-lattice interactions in polar crystals is studied. Various approaches to the model are considered. Particular attention is given to calculations of the polaron ground state energy, and of the field contribution to the particle mass for intermediate coupling strengths. (T.F.H.)

2665 FREE FIELDS AND MULTILINEAR ALGEBRA OVER HILBERT SPACES. D. Kastler (Institut de Physique Theorique, Marseille). p.305-16 of "Lectures on Field Theory and the Many-Body Problem." New York, Academic Press Inc., 1961.

In order to construct a free field, it is necessary to find the one-particle Hilbert space H of the free field equation; the Green's function corresponding to H; and the tensorial algebra over H (symmetric for bosons, antisymmetric for fermions). This type of description of a free field is applied to the second quantized Schrödinger equation; the scalar neutral field; the electron-positron field; and the photon field. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 1929, 1975, 1982, 1995, and 1997

2666 (AAEC/E-61) GRAPHITE FUEL STUDIES. PART 3. COMPACTION OF GRAPHITE AND MIXTURES OF GRAPHITE AND FISSILE AND FERTILE MATERIALS. J. R. May (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1961. 35p.

Sound high density cylinders of graphite were made by cold compacting finely ground artificial graphite at pressures of 60 tsi. Cylinders could be made only if the graphite used was 50% finer than 10 microns and freshly ground. Storage of the powder in moist atmospheres or heating of the powder reduced its compacting properties. Uranium and thorium metal powders and uranium and thorium oxide up to 60 wt % equivalent metals were added to the graphite and sound cylinders made from the mixtures. The compacts were heated to high temperatures (up to 2800°C) to convert the metals or oxides to carbides which rapidly hydrolyze in moist air. Measurements of compressive strength and density changes and investigation of the properties of the compacts of thermal cycling were made. Compacts made from metal powders are considered satisfactory for use as fuel for a High Temperature Gas Cooled reactor system provided their irradiation stability is satisfactory. (auth)

2667 (AEEW-M-95) A NOTE ON ERRORS ARISING IN FINITE DIFFERENCE REPRESENTATIONS OF CONTROL ROD EFFECTS. M. N. John (United Kingdom Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). July 1961. 11p.

Two methods for the representation of moving control rods are defined. These methods may be used in analog and digital computer studies on finite difference models of axial transients. The errors involved in their use are evaluated for a typically severe case of flux distortion by comparison with a one-group diffusion theory approach. It is shown that either method, maximum error in rod penetration does not exceed about 0.06 of an interval for a 16 interval model or 0.17 of an interval for an 8 interval model. However, changes in reactivity are estimated much more accurately by the "quadratic" method than by the "linear" method. (auth)

2668 (ANL-6392) IDAHO DIVISION SUMMARY REPORT, OCTOBER 1960 THROUGH MARCH 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 75p.

Experimental Breeder Reactor-I. Three methods were used to determine the reactivity worth of the EBR-I lead cup reflector to be 5.4%. The feedback mechanism postulated for the resonant instabilities of Mark-II core is discussed in some detail. ZPR-III. Criticality and reactivity measurements for a wide variety of materials are reported for Assemblies 29 to 31 (uranium oxide) and 32 to 33 (stainless steel-uranium). BORAX-V. Current development and fabrication work carried out on the BORAX-V facility are described. Transient Reactor Test Facility. Results are presented for a 1010-Mw-sec temperature-limited transient in the facility and for the integrated and peak power as a function of reactivity addition. A temperature rise vs power graph was derived for calculating the energy release of transients. Gamma flux measurements are discussed. (D.L.C.)

2669 (ANL-6454) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1961. (Argonne National Lab., Ill.). Nov. 15, 1961. Contract W-31-109-eng-38. 58p.

Progress is reported in the development of Water Cooled Reactors, EBWR, BORAX-V, Sodium Cooled Reactors, EBR-I, EBR-II, thermal and fast reactor safety studies, nuclear physics, reactor fuels, heat engineering, separations processes, and advanced reactor concepts. (M.C.G.)

2670 (APAE-Memo-293) SUMMARY NUCLEAR CALCULATIONS FOR THE SM-2 CORE 1. B. E. Fried, R. H. Beam, and P. E. Bobe (Alco Products, Inc., Schenectady, N. Y.). Sept. 25, 1961. Contract AT(30-3)-326. 56p.

The results of a limited analysis of the extended SM-2 critical experiments are given. A review of the analytical models is presented to ascertain the accuracy of the reactivity calculations for the reference SM-2 Core I. A new reference B-10 loading was derived based on analysis and experimental measurements. Calculations of power distributions and burnup behavior of the reference core are presented and comparisons to available measured data made. (auth)

2671 (BNL-5748) EXAMINATION OF HFBR PROTOTYPE FUEL ELEMENTS AT MTR. Metallurgy Memo No. 913. J. R. Weeks (Brookhaven National Lab., Upton, N. Y.). Oct. 17, 1961. Contract [AT(30-2)-Gen-16]. 18p.

The fuel element BNL 18-1, the irradiation history of which is tabulated, was examined, photographed, and disassembled in the MTR hot cell. The appearance of each plate surface was sketched, and samples for other analyses were marked. Descriptions of observations made during the operation are included. (J.R.D.)

2672 (CEND-87) THE DEVELOPMENT AND TESTING OF HOMOGENEOUS CERAMIC FUELS. Summary Report. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). May 1960. Contract AT(30-1)-2379. 52p. (NYO-2991)

Studies were made on the formation of face-centered cubic solid solutions in the UO_2-ZrO_2-CaO and UO_2-CeO_2 systems upon sintering. An extensive series of face-centered cubic solid solutions was produced by sintering UO_2 and ZrO_2 pre-stabilized in cubic form with 10 wt % CaO. Stabilization of ZrO_2 with 15 or 20 wt % CaO produces some $CaZrO_3$ which, however, reacts with UO_2 contents of 25 to 50 wt % to form part of the homogeneous solid solution. Single-phase UO_2-ZrO_2-CaO pellets containing up to 25 wt % UO_2 were found to have excellent thermal resistance. Density, shrinkage, and weight loss for selected compositions vacuum-sintered at 1800°C and heated in argon and in air at 1000°C were measured. UO_2-CeO_2 systems containing 20 and 40 wt % UO_2 were also found to form single-phase face-centered cubic structures upon being sintered. (D.L.C.)

2673 (CNEN-112) SU ALCUNE MODIFICHE APPORTATE AL REATTORE RC-1. (Modifications made in the RC-1 Reactor). M. Marseguerra, F. Marsili, and S. Sciuti (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia). Aug. 1961. 23p.

The modifications made in the RC-1 Reactor to improve flexibility are described. The design and the construction of all the parts, with the exception of the Al liner, were performed. (auth)

2674 (CRL-69) REACTOR SITING IN CANADA. G. C. Laurence (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 23, 1961. 12p. (AECL-1375)

Approval of the location for a nuclear reactor in Canada depends on consideration of all safety aspects of its design and operation. Therefore it is not subject to a general code of regulations. In comparing sites, curves are drawn to show the number of persons residing within a circle of radius r about the reactor. Comparison is made with a reference population distribution which is acceptable for a 1000 Mw(t) power reactor that is constructed and operated according to the principles of safe practice that are normally expected in Canada. In comparing sites in respect to proximity to population, it is suggested that population density be weighted in inverse proportion to the cube of the distance from the reactor. Integration of the weighted population density over the countryside beyond the plants' boundary or exclusion area gives a population index for comparison with that of other sites. (auth)

2675 (DP-632) HEAVY WATER COMPONENTS TEST REACTOR, SAVANNAH RIVER PLANT. STRESS ANALYSIS OF THE REACTOR VESSEL. H. W. Bellas (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S.C.). Aug. 1961. Contract AT(07-2)-1. 86p.

The stresses in the reactor vessel of the Heavy Water Components Test Reactor were predicted under transient and steady-state temperature and pressure. It was concluded that if operating experience bears out expectations the vessel may be subjected to approximately 5000 stress cycles without exceeding the fatigue limit. (auth)

2676 (GEAP-3800) CONTROL WORTH OF B_4C RODS. G. C. Pomraning (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 30, 1961. Contract AT(04-3)-361. 60p.

An analytic model was developed for transforming a linear array of cylindrical control elements into an equivalent slab which has the same worth. The model was applied to a simple cell using a multigroup code. For a strong 1/v absorber in high concentration, such as B_4C rods, it was found that the standard three-group scheme was not sufficient. It was necessary to break up the epithermal group into three groups, resulting in a five-group calculation. It appeared that the ratio of total worth to thermal worth as calculated is slightly higher than would be expected from experiment. (auth)

2677 (HW-66119) PROGRESS IN PLUTONIUM RECYCLE RESEARCH AND DEVELOPMENT. Herbert M. Parker and Laurance H. McEwen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1, 1960. Contract [AT(45-1)-1350]. 36p.

Presented at the International Atomic Energy Agency Symposium on Small and Medium Power Reactors at Vienna, Austria, September 5 to 9, 1960.

Progress is reviewed on studies on recycling of plutonium in thermal reactors including treatment of plutonium as a supplement to, as well as to supplant, the use of enriched uranium. The recycling of plutonium in aggregations of reactors as contrasted to recycle in an isolated reactor was considered as was also the reactivity lifetime attainable with plutonium bearing fuels and the effect of enrichment level on plutonium fueling economics. The discussion includes physics experiments on the critical mass of H_2O-moderated, plutonium-bearing rod arrays, lattice parameter measurements, and planned use of a special critical facility for measurements on irradiated, plutonium-bearing fuel assemblies. Mentioned also are measurements of cross-sections of plutonium isotopes. Information is presented on the development of methods for the fabrication of plutonium—aluminum-alloy core, Zircaloy clad, spike enrichment fuel assemblies for initial loading of the Plutonium Recycle Test Reactor. Recent progress in the development of fabrication techniques for ceramic fuel cores (cold and hot swaging; vibratory compaction) especially attractive for semi-remote fabrication of fuel containing high exposure plutonium is likewise reviewed. Fuels reprocessing research on methods attractive for use with plutonium enriched fuel cycles are highlighted; emphasis is given to fused-salt techniques focused on close-coupled recycle concepts. A summary description is provided of the plutonium enriched, 85 tube, 70 Mw, D_2O moderated Plutonium Recycle Test Reactor and of fueling plans during subsequent operation. (auth)

2678 (HW-67169) TEST OF D REACTOR NOZZLES MODIFIED FOR BUMPER ELEMENTS. J. D. Maguire (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 21, 1960. Contract AT(45-1)-1350. 7p.

Tests were made on D reactor nozzles modified for bumper elements by subjecting them to cycles of the various impact, torque, and pressure forces that may be expected to be encountered in normal reactor charging operations. Data were collected and information was recorded as to damage caused by certain of these forces to associated equipment such as caps, cap tightening screws, and lug rings. No failures of the nozzles occurred during the course of testing under conditions which simulated the worst cases which could be expected. (auth)

2679 (HW-68832) THE EFFECT OF EDTA ADDITION ON REACTOR EFFLUENT RADIOACTIVITY. W. B. Silker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 13, 1961. Contract AT(45-1)-1350. 4p.

The tetra-sodium salt of EDTA was added to reactor coolant to determine its effect on the concentration of parent materials on the corrosion films on fuel elements and process tubes and on reactor effluent radioactivity. Results indicated that the chelating agent apparently not only reacted with the ions in solution to form a compound which did not enter into reaction with the corrosion film, but also competed favorably for metal ions already bound into the film structure. (M.C.G.)

2680 (HW-69060) THE EFFECT OF IRON ON REACTOR EFFLUENT RADIOACTIVITY. W. B. Silker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 20, 1961. Contract AT(45-1)-1350. 4p.

An investigation is described in which the concentration of iron in the process water flowing to two reactor tubes was increased tenfold for a period of five days by addition of ferric chloride. The effluent from these tubes was sampled and analyzed radiochemically prior to, during, and for sometime after these additions. Data from the analyses are presented and discussed. (J.R.D.)

2681 (HW-69200(Pt.2)) PLUTONIUM SPIKE FUEL ELEMENTS FOR THE PRTR. PART II. THE MARK 1-H. R. E. Sharp (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1961. Contract AT(45-1)-1350. 33p.

The process and specifications used in fabricating the first plutonium spike core loading for the Plutonium Recycle Test Reactor power tests are described. The Mark I-H elements were fabricated at a comparable cost to the 19-rod cluster UO_2 feed elements used in the PRTR. Drawings are included showing the dimensions used. (M.C.G.)

2682 (HW-70980) RADIOISOTOPE CONCENTRATIONS IN THE PRTR PRIMARY COOLANT AND HELIUM SYSTEM DURING OPERATION WITH A FAILED FUEL ELEMENT(S). R. W. Perkins and C. W. Thomas (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 7, 1961. Contract AT(45-1)-1350. 15p.

Measurements of the fission products in the Plutonium Recycle Test Reactor primary D_2O and helium system reaffirmed the presence of defective fuel elements. Bursts of fission gases following reactor startup or increases in power level were observed. Under the reactor's operating conditions they were equivalent to that produced in 150 grams of uranium. These activity bursts frequently increased the specific activity of the helium system by two orders of magnitude (and one order of magnitude in D_2O) and were clearly defined by the gross gamma monitors. It was concluded that a rupture monitor must be designed to provide almost instantaneous comparison of the reactor's 85 tubes if it is to be successful in pinpointing defective fuel element locations. (auth)

2683 (IDO-16671) ETR SPRING LATCH CONTROL ROD. L. J. Harrison (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 10, 1961. [Contract AT(10-1)-205]. 11p.

The latching mechanism for the control rods of the Engineering Test Reactor was redesigned substituting a spring latch. The new latching mechanism also permitted increasing the number of plates in the fuel section from 14 to 16 without decreasing the size of the coolant channels. A prototype was built and tested both out of and in the reactor. A conversion and inspection procedure was established for the rods. (auth)

2684 (NAA-SR-5410) DISPOSAL OF OMR HIGH BOILERS BY COMBUSTION. R. R. Stiens (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1961. Contract AT(11-1)-GEN-8. 39p.

Under the influence of radiation, the coolant-moderator in an organic moderated reactor slowly decomposes to form high molecular weight polymers (high boilers) and a mixture of gases and light hydrocarbons as waste products. Work carried out on the improvement and subsequent operation of a prototype waste-polymer combustion process is described. Operation of the improved unit employing a "vortex" burner confirmed the feasibility of combustion as a disposal method. It was determined that fuel temperatures of 400°F and combustion air temperatures of 300°F were required for successful operation. The quantity of ash resulting from the combustion was established to be less than 0.5 wt % of the original polymer. It was determined that the efficiency of the primary dust collector varied from approximately 90 to 99%, and that there was no detectable particulate matter in the gas leaving the absolute filter. Attempted activity-balance calculations proved unsuccessful due to extreme difficulties in measurement of the low-level activity of the stack gas. In an effort to further improve and simplify the process system, preliminary evaluation of another burner was carried out. A cost estimate of the combustion process using the "Vortex" burner was prepared, based on data obtained from the Piqua, Ohio, organic reactor power plant design, and operating data from the current combustion prototype. Results indicated a net cost of 1.8 cent/lb for burning the polymer in a Piqua-size plant. (auth)

2685 (TID-13914) INFORMAL PROGRESS REPORT [ON FUEL ELEMENTS]. [J. L. Zambrow] (Sylvania Electric Products Inc., Bayside, N. Y.). Sept. 1961. Contract [AT(30-1)-Gen-366]. 7p.

The temperatures and burnups being sustained by U–Y alloys under irradiation in SR-1 and SR-2 capsules are reported. Some experiments on the converion of UF_4 to UC are described in which the product from two UF_4–Si–C mixtures was found to contain UC + UC_2 and UC, respectively. (D.L.C.)

2686 (TID-14160) HYDRAULIC STUDY OF A WATER WALL FOR ATOMIC REACTOR. E. Roy Tinney (Washington. State Coll., Pullman. R. L. Albrook Hydraulic Lab.). June 1958. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350. 48p. (GEH-25086)

Modifications of the water wall, the supply piping, and the feeder lines were made. Three series of tests were run to determine the effect of these modifications on the flow distribution within the water wall, the pressure losses, and the stability of the flow. Comparison of the results of these tests with those made during the initial phase of study was made to determine the feasibility of the modifications. The mathematical procedure for analytically determining the flow and pressure distribution within the water wall was refined. Correlation was made between the mathematical results and the actual measured flow conditions. (auth)

2687 (TRG-Report-46) FTD2- A 2-DIMENSIONAL FLUX AND TEMPERATURE DISTRIBUTION PROGRAMME FOR THERMAL REACTORS. J. A. Enderby (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). June 9, 1961. 31p.

FTD2 is an IBM 704 program that performs a 1- or 2-group, 2-dimensional flux calculation, followed by a heat-transfer calculation, to give channel-by-channel fluxes and temperatures. The fuel channels are assumed to lie on a square mesh and the reactor cross-section is divided into regions corresponding to a single fuel cell, consisting of the fuel assembly and the surrounding graphite. Up to 100 different types of region are allowed and the regional properties may be distributed in any way whatsoever. Any region may be an absorbing region to represent an absorber or control rod on the fuel lattice and there are also facilities for placing absorbers in interstitial positions. The program can calculate long-term reactivity effects on flux and temperature, and the effects on the long-term reactivity of changing fuel during the irradiation period can be readily allowed for. (auth)

2688 (AEC-tr-4677) ON THE THERMALIZATION OF NEUTRONS IN A HETEROGENEOUS REACTOR. A translation of "O Termalizatsii Neitronov v Geterogennom Reaktore." A. D. Galanin (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 13p.

The thermal utilization coefficient is calculated for a large heterogeneous reactor. The calculation is carried out in the diffusion approximation using a heavy-gas model for the moderator. The slowing down of neutrons in the uranium lumps and absorption in the moderator are neglected. The solution of the slowing-down equation uses the method of neutron groups. In the limiting case of small fuel lumps a simple analytical expression is obtained for the thermalization corrections. For dimensions of practical interest, the results of a calculation are presented which agree satisfactorily will with the results of a numerical solution to the integral slowing down equation. The insufficiency of using only the diffusion approximation to determine the diffusion corrections to the thermal utilization is discussed. (auth)

2689 (AEC-tr-4708) EXPERIMENTAL INVESTIGATION OF EFFECTS OF INTERACTION OF TWO SUBCRITICAL REACTORS. A translation of "Eksperimental'noe Izuchenie Effektov Vzaimodeistviya Dvukh Podkriticheskikh Reaktorov." A. V. Kamaev, B. G. Dubovskii, V. V. Vavilov, G. A. Popov, Yu. D. Palamarchuk, and S. P. Ivanov (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 10p.

Criticality results are given for experiments on the interaction of two subcritical reactors for two different configurations. One configuration (homogeneous) was two cylinders filled with an aqueous solution of $UO_2(NO_3)_2$ and spaced at different distances apart. The other configuration (heterogeneous) was a steel tank containing two Al grids with various loadings of U blocks and filled with water. The interaction at large distances in water was found to be much less than in air. (D.L.C.)

2690 (TT-985) HEAVY-WATER REACTORS COOLED BY LIGHT-STEAM AND WATER MIXTURES. M. Silvestri. Translated by D. A. Sinclair (National Research Council of Canada, Ottawa) from Energia nucleare (Milan), 8: 209-12 (1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 18992.

2691 THE PLANAR EDGE PROBLEM FOR TWO-DIMENSIONAL RECTANGULAR LATTICES. L. Trlifai (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Atomnaya Energ., 11: 221-9(Sept. 1961). (In Russian)

During the calculation of multiregion heterogeneous reactors, assumptions must be made for the neutron density at the boundary of two regions or of the core and the reflector. If the dimensions of the regions and the radius of curvator of the boundary are large, the necessary conditions must be derived by solving the problem of neutron density divided into two infinite lattices separated by a flat boundary. Consideration of the thermal neutron distribution on the surface of 2 semi-infinite two-dimensional rectangular lattices led to the solution of Riemann's edge theorem. According to the analysis of the approximate solution, the asymptotic neutron density and its derivative are continuous at the boundary if the lattices are replaced by a homogenized medium. Problems involving lattices with an infinite reflector or moderator may be solved in a similar manner. (TTT)

2692 THE DRAGON PROJECT. PART III. J. Planquart (Centre d'Études Nucléaires, [Saclay, France]). Bull. inform. assoc. belge develop. pacifique energie atomique, No. 33, 11-15; 17-19(July 1961). (In French)

In this third part of the report on the Dragon Project, the general concept of the reactor is reviewed. Then the heat exchange system, the fuel elements, reactor control, and removal of fission products are described. The characteristics of the reactor are tabulated. (J.S.R.)

2693 FOG COOLING OFFERS HIGHER EFFICIENCIES. G. A. Pon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nuclear Technol., No. 2, 34-8(Fall 1961).

The possibility of fog-cooled heavy water moderated reactors is examined. Data from fundamental studies of fog cooling are reviewed. A system is proposed in which the pressurized heavy water coolant is replaced by wet light water steam. The wet steam or fog is dried and taken directly to the turbine. The system is examined as a possible replacement for the CANDU type of reactor. A schematic diagram of a power plant cycle is presented and the flow characteristics and data from a parametric study are discussed. It is concluded that the concept of fog cooling is efficient and attractive economically. (C.H.)

2694 LUBRICANTS FOR NUCLEAR REACTORS. P. E. B. Vaile (Mobil Oil Co. Ltd., Coryton, Stanford-le-Hope, Essex, Eng.). Engineer, 212: 640-2(Oct. 20, 1961).

Characteristics of conventional and specialty nuclear lubricants are described. Radiation effects on lubricant performance are discussed. It is concluded that there is still scope for producing specialty nuclear lubricants which will withstand higher temperature and radiation levels than current products, but design trends indicate more severe operating conditions in the future. (L.N.N.)

2695 AXIAL TEMPERATURE DISTRIBUTION FOR A NUCLEAR REACTOR WITH SINUSOIDAL SPACE AND EXPONENTIAL TIME-VARYING POWER GENERATION. W. O. Doggett (North Carolina State Coll., Raleigh) and E. L. Arnold. J. Heat Transfer, 83: 423-31(Nov. 1961).

Analytic temperature distributions are obtained for the fuel and coolant regions of a heterogeneous, convection-cooled reactor with axial power variation $e^{wt} \sin (\pi z/H)$. The fundamental assumption in the governing differential equations is that the temperature distribution in the fuel region does not vary in the direction transverse to the coolant flow. The solutions involve two and three-parameter integrals encountered and numerically evaluated previously which are integrated herein and arranged in a form suitable for desk calculations. Closed-form expressions are developed for the final steady-state axial distributions which are applicable at times long in comparison with the characteristic temperature-response times. (auth)

2696 STEADY STATES IN REACTORS WITH POSITIVE REACTIVITY COEFFICIENTS. D. L. Booth (English Electric Co. Ltd., Whetstone, Leicester, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 69-75 (Oct. 1961).

The phenomena associated with the existence of two steady states with equilibrium xenon poisoning, for a given distribution of fuel and absorbers, are described. A general method for determining the conditions for spatial flux instability from an analysis of steady state flux distributions is presented as a related phenomenon. (auth)

2697 STREAMING DUE TO HOLES IN A REACTOR. C. Carter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 76-80(Oct. 1961). (AERE-R-3367)

The effect of holes on a reactor is considered by using appropriate boundary conditions on the asymptotic neutron flux at the surface of the holes. For a flux variation along the hole, this method gives the same streaming correction as Behrens, but for a flux variation across the hole, the streaming correction is smaller than that given by Behrens' formula. Values of the radial streaming correction factor are compared with experimental and Monte Carlo results and also with values obtained from an iterative method. (auth)

2698 REACTOR KINETICS: INTEGRAL EQUATION FORMULATION. F. T. Adler (Univ. of Illinois, Urbana). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 81-5(Oct. 1961).

The non-linear reactor kinetics equations are reduced to an integral equation for the neutron density which appears particularly suitable for computer applications. The computer program described consists primarily of summing operations and appears to lead to better stability for equivalent time steps than other approaches. Any number of delayed neutron groups can be handled. (auth)

2699 THE EFFECT OF CYLINDRICAL AIR VOIDS IN A HIGHLY ENRICHED WATER-MODERATED CORE. P. N. Cooper, W. M. Cooper, and K. Firth (Associated Electrical Industries ltd., Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 86-90 (Oct. 1961).

Measurements were made in a light-water-moderated, highly-enriched, uranium-fueled, sub-critical facility of the variation in critical mass with diameter of a central air void. These measurements indicated that there would be no transient increase in reactivity if a central void were to collapse radially. Other measurements on the slow flooding of a 3 in. diameter central air void showed that there was a slight addition of reactivity in the early stages, reaching a maximum of about 0.1 per cent, but that a completely flooded void was much less reactive than the empty void. Two-group diffusion theory calculations for the initial and final states indicated that the results of the measurements were not affected by small changes in the enrichment of the uranium. (auth)

2700 INFLUENCE OF A CYLINDRICAL CHANNEL ON A NEUTRON FLUX WHICH VARIES LINEARLY IN A DIRECTION PERPENDICULAR TO THE AXIS OF THE CHANNEL. C. Carter and R. J. Jarvis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 113-19(Oct. 1961). (AERE-R-3366)

The perturbation of the neutron flux in an infinite medium caused by a cylindrical channel is investigated, when the unperturbed flux varies linearly in a direction perpendicular to the axis of the channel. The channel in fact behaves as a dipole and the dipole strength is calculated as a function of the channel radius. (auth)

2701 PLEXIGLAS- AND GRAPHITE-MODERATED PLUTONIUM ASSEMBLIES. A. Goodwin, Jr. and C. L. Schuske (Dow Chemical Co., Rock Flats Plant, Denver). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 120-9(Oct. 1961). (RFP-202)

The critical masses of plutonium-Plexiglas and plutonium-graphite mixtures were determined. The experimental data were derived from sub-critical neutron multiplication measurements on cylindrical assemblies containing these mixtures. The atomic ratios of moderator-to-fuel ranged from H : Pu = 0 to ~100 and C : Pu = 0 to ~10. Theoretical values of critical masses were derived for water- and graphite-moderated systems of plutonium using 16-group transport and diffusion calculations. The atomic ratios of moderator-to-fuel ranged from H : Pu = 0 to ~1000 and Cu : P = 0 to ~35,000. (auth)

2702 IRRADIATION OF URANIUM-METAL AND URANIUM-OXIDE FUEL PINS TO HIGH BURN-UP AT HIGH TEMPERATURE. L. R. Blake (Dounreay Experimental Reactor Establishment, Caithness, Scotland. J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 15: 140-59(Oct. 1961).

Fuel pins are tested in Dounreay Materials Testing Reactor (D.M.T.R.) under onerous fast-reactor type irradiation conditions, and achieved a high burn-up at higher temperature and rating than heretofore achieved. The fuel pins are representative of a fast power reactor but scaled down proportionally to reduce the diameter to 0.122 in. o.d., which enables a high power density of 550 W/g to be used, so reducing irradiation time to 17 days per 1 per cent burn-up. Uranium-metal is irradiated to 4.75 per cent burn-up at 700°C center-temperature, and uranium oxide is 5.3 per cent burn-up at 1600°C center-temperature, in 0.011 in. thick cans of Nimonic 80 at 500°C fuel surface temperature approximately. The pins survive with no measurable distortion. A proposal is made to achieve high burn-up by introducing about 30 per cent void space in the fuel and containing it in a strong can. Theory suggests that the pins are capable of three times this burn-up, and this is partly confirmed by post-irradiation, high-temperature tests. A rig is developed to test the fuel pins in D.M.T.R. at high power density under controlled temperature conditions. A technique is also established of x-raying the complete rig and returning it to the reactor, thus enabling fuel swelling and distortion to be measured and plotted during the irradiation. (auth)

2703 THE DEVELOPMENT OF HOMOGENEOUS REACTORS AND THE EXPERIENCE WITH CZECHOSLOVAK PROJECT. Vladimir Zajîc (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 296-300(1961). (In Czech.)

Studies concerning a homogeneous reactor were made at the Institute of Nuclear Research of the Czechoslovak Academy of Sciences. The studies were subsequently discontinued. (L.N.N.)

2704 CALCULATION OF THE IRRADIATION COSTS OF REACTORS. W. Marth. Kerntechnik, 3: 435-40(Oct. 1961). (In German)

A calculation is made of the costs incurred during the production of radioactive substances with reactors. The most important types of common costs are listed and distributed, according to the cause, between irradiation and radiator experiments. In conclusion, a formula is proposed for the calculation of the costs of individual irradiation samples. The statements made can be applied, with slight modifications, to any type of reactor, and also make it possible to calculate the costs of radiator experiments. (auth)

2705 GERMANY: [REACTOR PROGRAMME]. Nuclear Eng., 6: 474-5(Nov. 1961).

The reactor program in Germany is discussed. An outline is given of the reactors in operation and under construction. (N.W.R.)

2706 PROGRESS IN NORWAY. I. THE HALDEN PROJECT. 2. RESEARCH AT KJELLER. Nuclear Eng., 6: 476-7(Nov. 1961).

The reactor program in Norway is discussed. One discussion concerns the Halden Project and the other the research at Kjeller. (N.W.R.)

2707 VOID MEASUREMENT IN A BOILING REACTOR. J. A. Thie, J. Beidelman, and B. Hoglund (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 11: 1-6(Sept. 1961).

The void fraction at several locations was measured. The technique used consisted in obtaining the cadmium ratios of cobalt wires, and then relating these to the local void content. This is possible because the thermal to epithermal flux ratio is approximately proportional to the local hydrogen density. Hydraulics calculations of this void fraction support these experimental results. (auth)

2708 NEUTRON THERMALIZATION IN PLANE LATTICES. Jacques Devooght (Université Libre, Brussels). Nuclear Sci. and Eng., 11: 7-18(Sept. 1961).

The problem of space dependent thermalization of neutrons is solved for a slab lattice of heavy moderator and fuel. Fuel slabs are replaced by negative plane sources whose strength is computed by transport-theoretical arguments. The Fourier space-transform of the spectrum is obtained by iteration of an integral equation and the solution correct to the order $O(\Delta^2_{mod})$ is shown to reduce, in the absence of fuel, to the one found by Hurwitz et al. The influence of the hardening of the spectrum incident on the fuel slab is studied by means of the thermal utilization factor. (auth)

2709 EFFICIENCY OF CYLINDRICAL CONTROL RODS PARTIALLY INSERTED IN A BARE REACTOR. J. Ligou (Groupement Atomique Alsacienne Atlantique, Le Plessis Robinson, France). Nuclear Sci. and Eng., 11: 26-38(Sept. 1961).

An extension of the method of Nordheim-Scalettar to the case of rods partially inserted in a bare reactor is described. Axial flux harmonics are introduced. It is assumed that the extrapolation distances of the rods for thermal neutrons still have the same value whatever their insertion length may be. This extrapolation distance can be calculated especially from data relative to rods of infinite length. Calculation methods for the determination of the efficiency of rod assemblies and the distribution of thermal neutron flux are described. It should be noted that the determination of the flux distribution may require the use of many more harmonics than the determination of rod efficiency, since the results converge more rapidly in the latter case. Significant examples are given. The calculation method was programmed to be used with a BULL Gamma AET Computer. (auth)

2710 SOME REMARKS ON THE EFFECT OF A NON-UNIFORM TEMPERATURE DISTRIBUTION ON THE TEMPERATURE DEPENDENCE OF RESONANCE ABSORPTION. Lawrence Dresner (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.). Nuclear Sci. and Eng., 11: 39-42(Sept. 1961).

The influence of a non-uniform temperature distribution on the absorption of neutrons in a purely absorbing resonance of an isolated lump is studied. It is shown that in practical situations, the absorption in the lump depends only on its average temperature and not on whether or not its temperature distribution is uniform. (auth)

2711 GENERAL STABILITY CRITERIA FOR NUCLEAR REACTOR WITH TWO FEEDBACK PATHS OF SINGLE TIME CONSTANT. J. Miida and N. Suda (Japan Atomic Energy Research Inst., Tokyo). Nuclear Sci. and Eng., 11: 55-60(Sept. 1961).

Stability criteria are derived for a nuclear reactor with a power coefficient feedback. The power coefficient feedback is assumed to consist of two feedback paths, each with a single time constant. In reality, the system of the nuclear reactor is often well approximated by this model. Criteria are given, by which one can quickly determine the stability, when parameters are known. They also give an insight into the effects of parameters on the stability of the nuclear reactor. The application of the criteria to a British-type gas-cooled reactor with a positive temperature coefficient of moderator is demonstrated. Comparisons are made with other works, of different approaches, on a fast reactor and a water-cooled reactor. (auth)

2712 AN APPROACH TO REACTOR PHYSICS USING RESULTS OF INTEGRAL EXPERIMENTS. PART II. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Nuclear Sci. and Eng., 11: 61-4(Sept. 1961).

A previous analysis of experimental data yielded a new procedure for the calculation of k_∞/ϵ. Corresponding values derived from conventional theoretical techniques are analyzed in a similar fashion. The results as presented amplify the discrepancy between cadmium ratio measurements and conventional resonance escape theory. A suggestion for improving the accuracy of cadmium ratio measurements is also presented. It is shown that the previous general development can be utilized with slight modification to yield values for the resonance escape probability which are in essential agreement with values calculated by conventional techniques. (auth)

2713 DISADVANTAGE FACTORS IN SLAB GEOMETRY BY THE P_2 CALCULATION. John O. Mingle (Kansas State Univ., Manhattan). Nuclear Sci. and Eng., 11: 85-9 (Sept. 1961).

The theory of the P_2 calculation for a two-region cell in slab geometry is presented. In this treatment the boundary condition of Davison is employed. By this method an upper bound, furnished by the P_2 model, and a lower bound, furnished by a P_1 model, are obtained on the disadvantage factor. It is suggested that a single best estimate is normally the average of the two. (auth)

2714 ON THE GENERAL SOLUTION OF THE REACTOR KINETIC EQUATIONS. Jeffery Lewins. Nuclear Sci. and Eng., 11: 97(Sept. 1961).

Previous results (NSA, 15: 7043) are extended under the assumption that the effectiveness γ_i of delayed neutrons is the same for all the i species. The present results are expressed through coefficients for the determination of the partial fraction expansion of G(s) and H(s). When γ departs from unity, it is only necessary to employ an effective lifetime, $1/\gamma$, to retain the exact form by the authors. (L.N.N.)

2715 THE CONTROL OF NUCLEAR REACTORS. R. J. Cox and J. Walker (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs., (London), Pt. B, 103: 577-89(Sept. 1956).

Physical principles of nuclear reactors affecting the design of their control and instrumentation are described. Data are presented for kinetic behavior of the neutron flux for reactivity changes in reactor types. The nuclear reactions inherently produce nuclides, and effects of these on reactor control and operation are discussed. These nuclides include the delayed-neutron emitters, which cause a slowing down of reactor kinetic response; β- and γ-emitters, which continue to produce heat for a long time after the neutron reactions producing them are shut down; and fission-product poisons. Reasons are given for the system of neutron-flux instruments normally used, and details are given of the principles of design of the various types of instruments. (auth)

2716 TEHNICA REACTOARELOR NUCLEARE. (Nuclear Reactor Technology). L. Dobrescu. Bucharest, Academia R. P. R., 1960. 548p.

An introduction to the field of reactor technology is given. It includes chapters on the structure of the atom and the nucleus, the development of the science of radioactivity, nuclear reactions, fission and fusion processes, reactor design problems, reactor controls and breeding. Fertile and fissile materials are discussed in detail individually. Special attention is given to the problems of the disposal of solid, liquid and gaseous radioactive waste materials and the treatment of spent fuels. The chemical and physical properties of moderator, coolant and structural materials are discussed, together with materials used for the shielding and control of reactors. The book is not intended to be used as a design manual. It lists for comparison the economic factors involved in energy generation by nuclear and by conventional means. (334 references). (TTT)

2717 INTERPRETIVE REPORT ON OPERATING CONDITIONS FOR NUCLEAR PRESSURE VESSELS. K. F. Smith (Argonne National Lab., Ill.). Welding Research Council Bulletin Series Number 66. New York, American Welding Society and Welding Research Council, 1961. 12p. $1.00.

The status of nuclear pressure vessel operating parameters is summarized. Pressure vessels discussed are of the types used for pressurized water, direct cycle boiling water, and aqueous homogeneous reactors. The results show that design factors for water-cooled pressure vessels are clearly defined for pressure and temperature conditions, but not for corrosion and irradiation conditions. However, corrosion factors are believed to be less critical than those for the fuel core and external components but should be evaluated eventually by destructive examination of vessels. The factor of irradiation damage by fast neutrons, through elevation of the ductile-to-brittle transition temperature, is quite important but highly controversial, and the possibility of damage should be considered at integrated fast flux values in excess of 5×10^{17} nvt. Irradiation at 500 to 600°F is less damaging to vessel material than irradiation at temperatures below 500°F. The safe upper limit of integrated fast neutron flux for given operating temperatures of pressure vessels is not known. (N.W.R.)

2718 ISSLEDOVANIYA KRITICHESKIKH PARAMETROV READTORNYKH SISTEM. SBORNIK STATEI. (Investigation of Critical Parameters in Reactor Systems. Collection of Articles). P. A. Gavrilov, ed. Moscow, Gosatomizdat, 1960. 119p.

Nine articles are included on theoretical calculations of neutron fluxes and critical parameters in various reactor systems (uranium-beryllium, uranium-graphite, and aqueous mixtures of uranium and plutonium). Tables and graphs are plotted for critical parameters as functions of the relative concentration and character of fissionable material and moderator and for fuel enrichment. The theory and data are intended for engineering physicists, theoretical physicists, and technologists. (R.V.J.)

2719 IMPROVEMENTS IN OR RELATING TO BLOCKS FOR BUILDING PURPOSES. Norman Battle (to Rolls-Royce Ltd.). British Patent 877,534. Sept. 13, 1961.

Blocks suitable for building structures of moderating or shielding material for reactors may be made by forming the material in the shape of a regular hexagonal right prism or a parallelogrammic right prism. The end surfaces of the blocks have pyramidal recesses with apexes being on the axis of the prism, so that the recesses of one horizontal layer of blocks will engage the projections of another layer and thereby prevent lateral separation of the blocks. (D.L.C.)

2720 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Claude Robert and Jean Tillequin (to Commissariat a l'Energie Atomique). British Patent 881,790. Nov. 8, 1961.

A reactor suitable for mounting on a mobile platform is designed in which the disadvantages due to differential thermal expansion are reduced. The reactor comprises a core mounted in a pressure vessel by a first set of links, the vessel being mounted on support means by a second set of links. In this way, differential thermal expansion between core and vessel and between the vessel and the framework of a ship or aircraft is allowed, and the core weight is transmitted from the first set to the second set of links, avoiding distorting loads on the vessel. (D.L.C.)

2721 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Andre Huet. British Patent 881,840. Nov. 8, 1961.

A mechanism is designed for the simultaneous movement of both the reflecting panels and the fuel rods in a reactor in which the fuel rods are moved together or away from each other, as described in British Patent 857,675. The mechanism comprises systems of articulated links for moving the fuel rods; the panels are secured to end rods for movement therewith. (D.L.C.)

2722 IMPROVEMENTS RELATING TO CONTROL RODS FOR NUCLEAR REACTORS. John George Morland (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 881,853. Nov. 8, 1961.

A control rod assembly is designed with a shock absorber on its lower end and with means for indicating when the shock absorber is inoperative. The means comprises a support rod coupled to the assembly by means of shear pins; impact is absorbed by a buffer which breaks the shear pins, and the inoperativeness of the absorber is indicated by the slack of the lifting cable. (D.L.C.)

2723 IMPROVEMENTS IN OR RELATING TO POSITION INDICATING DEVICES. Joseph Raymond Pendleton and Richard Smart (to United Kingdom Atomic Energy Authority). British Patent 881,972. Nov. 8, 1961.

A position indicating device is designed for giving indication of the limit positions of reactor shut-off rods. The device comprises a single magnet attached to the shut-off rod and a pair of magnets spaced apart on the indication member in such a way that when the shut-off rod is in a "in" or "out" position, like poles of one magnet of the pair are spanned by the single magnet with consequent deflection of the indication member. When the rod is in an intermediate position, no deflection of the indication member occurs. The device can be operated within a reactor at temperatures up to ~600°C. (D.L.C.)

2724 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Stanley Philip Riley (to United Kingdom Atomic Energy Authority). British Patent 882,936. Nov. 22, 1961.

A reactor fuel element of the type in which fuel segments are arranged end to end and contained in a protective sheath is designed so that separation of the segments due to thermal cycling is prevented. In this element, the segments are keyed together at their neighboring ends, and the series of segments is keyed to the sheath at at least one point. (D.L.C.)

2725 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Robert James Haslam (to United Kingdom Atomic Energy Authority). British Patent 883,030. Nov. 22, 1961.

A reactor fuel element of the cluster type with a lattice of metal strips is designed in which voidage of fissile material between the ends of clusters is reduced. The cluster is characterized in that the fuel members extend into the spaces of the lattice and are suspended from the lattice by their end caps. (D.L.C.)

Power Reactors

2726 (ACNP-6116) PATHFINDER ATOMIC POWER PLANT; GASEOUS RELEASE EVALUATION ROUTINE. W. A. Bezella, C. L. Teeter, and L. D. Hill (Allis-Chalmers

Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 15, 1961. Contract AT(11-1)-589. 38p. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates.

The Gaseous Release Evaluation Routine was constructed to estimate the fractional release of stable fission gases from cylindrical uranium dioxide fuel elements during steady-state neutron irradiation. The equivalent-sphere hypothesis, as proposed by Booth, was used as the diffusion model. Fickian gas diffusion through the solid uranium dioxide fuel material, which is temperature dependent, is assumed to be the controlling release mechanism. Fuel temperatures are determined by means of a heat transfer model assuming only radial heat conduction through the fuel material. Axial variations in both heat generation and surface temperatures of fuel pellets may be considered by means of axial flux and surface temperature tables. The heat transfer model includes provision for the temperature dependence of the fuel thermal conductivity. The code will analyze fuel assemblies composed of as many as 15 axial elements. A maximum of 50 axial increments for each axial element may be volume-weighted and summed in obtaining the fractional release for each axial element. A maximum of 50 radial increments (cylindrical shells) may be volume-weighted and summed in obtaining the fractional fission-gas release for each axial increment. Volume-averaged fraction fission-gas releases for each axial increment and summed fractional gas release for an entire fuel element are printed out. The code was written for an 8K-IBM-704 computer. If the input and output data are on tapes, two tapes are required. A typical computing time for an assembly of four axial elements with each axial element further considered as 10 axial increments and 10 radial increments is 2 min. (auth)

2727 (ACNP-6119) PATHFINDER ATOMIC POWER PLANT TECHNICAL PROGRESS REPORT, APRIL 1961–JUNE 1961. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 14, 1961. Contract AT(11-1)-589. 117p. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates.

Preconstruction research and development of the Pathfinder reactor are reported for fuel element development, reactor mechanical studies, and nuclear analysis. (D.L.C.)

2728 (APAE-69(Vols.I,II and III)) SM-2 CORE AND VESSEL DESIGN ANALYSIS. (Alco Products, Inc., Schenectady, N. Y.). Mar. 8, 1961. Contract AT(30-3)-326. 955p.

A design analysis summary is presented for the SM-2 core and vessel as of July 1, 1960. (J.R.D.)

2729 (BAW-156) DEVELOPMENT AND TESTING OF LOW COST FUEL ELEMENTS FOR POWER REACTOR SERVICE. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). June 2, 1961. 15p.

The development of swaging and vibratory compaction processes for fabrication of clad UO_2 fuel rods is described. The cost is less than 50% of that for an equivalent core fabricated from pellets. The irradiation testing of vibratory filled and swaged UO_2 rods is reported for burnups from 2,000 to 12,000 Mwd/t UO_2; the results indicate that the rods are capable of excellent performance in power reactors. (D.L.C.)

2730 (DP-655) HEAVY WATER MODERATED POWER REACTORS. Progress Report, August 1961. L. Isakoff, comp. (Du Pont de Nemours (E. I.) and Co. Atomic Energy Div., Wilmington, Del.). Oct. 1961. Contract AT(07-2)-1. 22p.

At the end of August 1961, construction of the HWCTR was about 85% complete. Satisfactory performance was exhibited by two thin-walled tubes of unalloyed uranium metal during a Savannah River irradiation; the maximum exposure of these tubes essentially matched the highest level yet achieved by any of the fuel elements developed in the power reactor program to date. Fabrication of compacted uranium oxide tubes in Zircaloy sheaths for irradiation in the VBWR and at Savannah River neared completion. Further data were obtained on the bucklings of clusters of 0.5-inch-diameter rods of natural uranium oxide in D_2O moderator. (auth)

2731 (DP-665) HEAVY WATER MODERATED POWER REACTORS PROGRESS REPORT, SEPTEMBER 1961. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Nov. 1961. Contract AT(07-2)-1. 21p.

At the end of September 1961, construction of the Heavy Water Components Test Reactor was about 90% complete. Thirty-two compacted tubes of crushed, fused uranium oxide in Zircaloy sheaths were fabricated for irradiation tests and destructive evaluation. Irradiation tests of the tubes were started in the Vallecitos Boiling Water Reactor and at Savannah River. The fabrication process for the tubes included steps designed to exclude hydrogenous material from the oxide cores, thereby eliminating the probable cause of sheath failures in previous irradiations. Additional experimental data on heat transfer burnout of tubes in subcooled water at pressures of about 100 to 1000 psi showed that the burnout heat flux is not affected significantly by pressure in this range. The data were correlated in terms of water velocity and subcooling. (auth)

2732 (GA-2262) MARITIME GAS-COOLED REACTOR PROGRAM. TECHNICAL FEASIBILITY STUDIES OF FABRICATION TECHNIQUES APPLICABLE TO THE MANUFACTURE OF HIGH-DENSITY BERYLLIA TUBES FOR POTENTIAL UTILIZATION IN THE MARITIME GAS-COOLED REACTOR. Final Report, May 9 to June 30, 1960. Chester A. Bielawski, Edward A. Douglas, and John G. Theodore (Brush Beryllium Co., Cleveland). For General Atomic Div., General Dynamics Corp., San Diego, Calif. Contract AT(04-3)-187. 50p.

This report was originally issued as Brush Beryllium Co. Technical Report No. 179.

The development and preliminary evaluation of beryllia base cements are described for the joining of multiple beryllia segments. A UOX BeO body composition, amenable to air firing to high densities, was developed by additions of Al_2O_3. Also investigated were the BeO-MgO, BeO-ZrO_2, BeO-SiO_2 systems and binary additions of MgO-SiO_2, MgO-Al_2O_3, MgO-ZrO_2, Al_2O_3-SiO_2, Al_2O_3-ZrO_2, and ZrO_2-SiO_2. Singular additions of SiO_2 and SiO_2 in combination with Al_2O_3 or ZrO_2 did not improve the sinterability of UOX BeO in air atmospheres. Binary combinations of 1% Al_2O_3 + 2% MgO, 2% Al_2O_3 + 1% ZrO_2, or 1% MgO + 2% ZrO_2 beneficiated the sinterability of UOX BeO in air atmospheres comparable to the density ranges achieved by the singular additions of Al_2O_3. The exploratory studies on extrusion, isostatic and cold axial pressing, and the slip-casting fabrication of a beryllia, single-hole, hexagonal tube are reviewed. (auth)

2733 (GEAP-3581) NUCLEAR SUPERHEAT PROJECT FIFTH QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1960. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189.

Conceptual Design and Program Evaluation. Reactor design work has reflected requirements for preparation of cost estimates for a 300 Mw(e) Separate Superheat Reactor Plant complex. The major design features of the complex are single pass, light water moderator, and low enrichment UO_2 annular fuel configuration. The core power density is 37 kw/liter. The average heat flux is 148,000 Btu/hr-ft^2 with a maximum clad surface temperature of 1250°F. Analytical work done to establish the thermal effect of the superheat fuel element for specified rate of change of reactivity of various reactor core conditions, established maximum reactivity insertion rates. The reactivity effects of flooding the steam passages of the process tube were evaluated. The largest reactivity change occurred for the ganged rod case where there was relatively high leakage from small critical portion of the core, which is 8% $\Delta k/k$ but may be reduced by approximately a factor of 2 by utilization of burnable poisons. Fuel Technology. Capsule irradiations performed in the trail cable facility revealed: growth of the outside cladding occurring in each capsule irradiated; the UO_2 fuel material receding away from a plastically deformed clad after cooling; and axial growth observed in all capsules irradiated. Development work is in progress on low-thermal cross-section process-tube designs. This includes corrosion evaluations of zirconium process tubes and thin-wall stainless steel tubes filled with aluminum oxide powder. Samples have been fabricated and are on hand for a second dynamic erosion experiment for UO_2 powder. Corrosion and Coolant Chemistry. Difficulty has been encountered in maintaining a controlled atmosphere of H_2O_2 in the superheat corrosion test loop. Two runs have been performed, one of 780 hr where a non-uniform type of corrosion was noticed. Metallurgic examination of this corrosion specimen is reported. During the second run of 1200 hr operation an electrolytic decomposition element was installed to successfully maintain the gas atmosphere at 16 ppm O_2 and 2 ppm H_2 in the influent steam. Heat Transfer. 231 test runs have been completed on the once-through heat transfer experiment. Based on the results, design work on the conceptual design of a once-through coolant superheater is being initiated. The general conclusion drawn from test operating experience is that the once-through reactor can be built to operating beyond the so called "burnout point" because convective film coefficients are high enough to maintain the heated wall temperature within design limits. Mechanical Development. Performance tests on a steam dryer as part of a simulated nine-element process-tube fuel assembly were conducted. Satisfactory performance was obtained from superficial velocity to 5.5 ft/second with inlet moisture not greater than it was by weight. Mixed Spectrum Superheater Study. The design work has continued to support the conclusions of the initial study that the mixed spectrum superheater concept is feasible and economically attractive. (auth).

2734 (GEAP-3686) NUCLEAR SUPERHEAT PROJECT SIXTH QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1960. R. T. Pennington (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 300p.

The progress and results from the conceptual design, economic evaluations, and research and development work performed on the Nuclear Superheat Project are reported. Results are summarized for conceptual design and program evaluation, fuel technology, materials development, experimental physics, coolant chemistry, heat transfer, mechanical development, SADE, and mixed spectrum superheat study. (M.C.G.)

2735 (NDA-2143-18) MILITARY COMPACT REACTOR PROGRAM. DESCRIPTION OF INPUT PREPARATION AND OPERATING PROCEDURES FOR 9-NIOBE, AN IBM-7090 CODE. D. Yetman, C. B. Eisenman, and G. Rabinowitz (United Nuclear Corp. Development Div., White Plains, N. Y. and General Motors Corp., [Detroit]). Aug. 31, 1961. Contract AT(30-1)-2303. 31p.

A revision of the 9-NIOBE code for numerically integrating the time-independent neutron or gamma-ray Boltzmann transport equation is presented. The code revision is for the IBM 7090 and will calculate angular distribution, total fluxes, and currents for neutrons or photons as a function of energy or wavelength in a finite, multilayered, spherically symmetric configuration. (J.R.D.)

2736 (NDA-MEMO-2143-14) MILITARY COMPACT REACTOR PROGRAM DUCT STUDIES. R. Schamberger (United Nuclear Corp. Development Div., White Plains, N. Y. and General Motors Corp., [Detroit]). July 25, 1961. Contract AT(30-1)-2303. 21p.

The transmission of neutrons through several rectangular ducts was measured. Fast neutron dose rates and thermal neutron fluxes are reported. The experimental results are compared with those obtained using the ADONIS code. (J.R.D.)

2737 (NYO-9726) PM-3A NUCLEAR POWER PLANT SECONDARY SHIELD DESIGN. W. C. Siler (Jackson and Moreland, Inc., Boston). Sept. 1961. Contract AT(30-1)-2749. 134p.

The design, analysis, and selection of system components for functions related to secondary shielding and associated auxiliary systems for the Antarctic PM-3A Nuclear Power Plant are described. Backfill material characteristics, shielding and activation analyses, heat transfer analysis, backfill cooling system, water exclusion and removal system, and instrumentation and control are discussed. (M.C.G.)

2738 (PRDC-TR-45) MONTHLY TECHNICAL REPORT [ON FERMI REACTOR]. Report Period March 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 12p.

Development activities are reported on the following Fermi reactor subjects: Core A, Core B, fuel accountability, shipping containers, reactor safety, shielding, mechanical handling, instrumentation, liquid metal and steam systems, and test operations. (D.L.C.)

2739 (SL-1857-6) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report, August 15, 1961 to October 15, 1961. (Sargent and Lundy, Chicago). Oct. 25, 1961. 28p. For Illinois Inst. of Tech., Chicago. Armour Research Foundation. Sub-contract AT(11-1)-938.

Calculations and design drawings on a supplementary reactor containment design study were begun. A performance diagram and flow diagram as well as general arrangement drawings for the standard containment concept were prepared. A preliminary draft of the conceptual design report for the containment test facility was reviewed. (M.C.G.)

2740 (SRO-60) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, OCTOBER 1961. (Savannah River Operations Office, AEC). 18p.

Progress is reported on the AEC-AECL cooperative program, physics, engineering, metallurgy, computer program for cost optimization studies, the Heavy Water Components Test Reactor, and the Carolinas-Virginia Tube Reactor. (M.C.G.)

2741 (TID-8535) SMALL POWER REACTORS. CURRENT STATUS, RESEARCH AND DEVELOPMENT PROGRAM, AND ECONOMIC POTENTIAL AS OF JUNE 30,

1960. (Division of Reactor Development, AEC). Dec. 1960. 139p.

The state of technology and economic potential of small central station power plants were studied. Results are summarized in tables showing nuclear power plant performance characteristics, nuclear power plant capital and power generation costs, and fossil fueled power plant capital and power generation costs. Designs were considered for pressurized water reactors, boiling water reactors, heavy water reactors, organic reactors, sodium reactors, sodium fast reactors, and gas reactors. Even the lowest of the potential cost nuclear plants considered did not compete with fossil fuel plants consuming fuel at 35 cents per million Btu. (M.C.G.)

2742 (TID-14148) HYDRAULIC STUDY OF A WATER WALL FOR AN ATOMIC REACTOR. C. Lomas (Washington. State Coll., Pullman. R. L. Albrook Hydraulic Lab.). Sept. 1957. For General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 44p. (GEH-25087)

A model of one quadrant of a reactor water wall was built to study the flow of coolant into a reactor with emphasis on the distribution, stability, and losses. It was found that the pressure loss in the inlet nozzle is the sum of entrance loss, contraction loss, bend loss, change in velocity head, and friction loss. Wall-developed cavitation almost tripled the loss coefficient. Essentially all of these losses were some function of throat velocity or Reynold's number. There was no indications of instability of the flow in any of the tests conducted on the water wall. The distribution of flow appeared to be satisfactory. Pressure drops in the $1^{3}/_{8}$ in. stay tubes were considered negligible for the maximum flow tested. Pressure drops for the $1^{7}/_{8}$ in. stay tubes were greater but not considered excessive. (M.C.G.)

2743 (UCRL-6590) PROJECT PLUTO CONTROL SYSTEM DEVELOPMENTS AND TEST RESULTS. R. E. Finnigan and G. G. Nelson (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 21, 1961. 63p.

Paper to be presented at the American Rocket Society Space Flight Report to the Nation, October 1961.

Tory II-A, the first experimental reactor in the Pluto nuclear ramjet missile program, was successfully tested. The methods of control which are employed on Tory II-A are summarized and unclassified test results pertaining to the major control systems are presented. Recent control system developments for Tory II-C, a flight-type ramjet reactor, are also described. The Tory II-C application requires 40-inch, linear-stroke servo actuators capable of operating in a high radiation environment throughout the temperature range of 70 to 1200°F. The problem areas and recent advances in the development of high-performance electropneumatic control systems for this application are discussed. The major control problems confronting the Pluto program are outlined and the further development efforts required are indicated. (auth)

2744 THE INFLUENCE OF PRESSURE TUBE DESIGN ON THE EXCESS-REACTIVITY OF A GAS-COOLED, HEAVY-WATER MODERATED NATURAL-URANIUM REACTOR. H. N. Schludi. Atompraxis, 7: 378-84(Oct. 1961). (In German)

In a CO_2 gas-cooled, heavy-water moderated natural uranium reactor with a net output of 100 mw and a constant load of 21.4 UO_2, three different kinds of pressure tubes were investigated. A conventional hot pressure tube with calandria was compared with a cold once-through pressure tube and with a cold twice-through pressure tube. The investigation shows a significant advantage of the cold once-through pressure tube as far as the reactor physics is concerned, compared with the conventional hot pressure tube. The cold once-through pressure tube has a much higher fuel burn-up and a lower heavy-water inventory. On the other hand, a cold twice-through pressure tube compared with a hot pressure tube with calandria does not show this advantage any more. A higher burn-up is cancelled out by the larger heavy-water inventory. (auth)

2745 CONCRETE CONSTRUCTION AT TRAWSFYNYDD NUCLEAR POWER STATION. Concrete and Construct. Eng., 56: 307-14(Sept. 1961).

The types, amount, and structural design of the concrete construction at Trawsfynydd, North Wales are discussed. The discussion also concerns the foundations used for the different structures and wall finishes. (N.W.R.)

2746 RESEARCH IN THE FIELD OF NUCLEAR POWER. Václav Stach (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 337-43(1961). (In Czech.)

Nuclear power research in Czechoslovakia is described. The types of reactors are limited but the problems are extensive. Problems in reactor physics and technology are discussed, and equipment used to study this field is described briefly. (N.W.R.)

2747 STRESS-RELIEVING ON SITE AT HUNTERSTON. REACTOR VESSEL SUCCESSFULLY HEAT TREATED. (General Electric Co., Ltd., Eng.). Metallurgia, 64: No. 384, 185-8(Oct. 1961).

Successful completion of the stress-relieving of the first 70-ft diameter reactor pressure vessel at Hunterston Nuclear Generating Station, Ayrshire, Scotland, is reported. The vessel was heated to a temperature of 550°C, soaked for 12 hours, and then allowed to cool slowly. The tests included crack-detection tests on 10% of all nozzle welds on the inner heat shield and on the grid, and 100% in the shell and on the gussets. Ultrasonic examination of selected areas on the top and bottom crowns was also carried out. The test showed the absence of faults. The electrical heating system used is described along with the temperature measurements made. (N.W.R.)

2748 MATERIALS PROBLEMS IN STATIONARY AND MOBILE POWER REACTORS. Ulysses M. Staebler (U. S. Atomic Energy Commission, Washington, D. C.). Metals Eng. Quart., 1: No. 2, 112-23(May 1961).

Problems in which economics is an important factor are discussed. Emphasis is placed on problems associated with reactors intended for production of electric power, heat processing, or maritime propulsion. Recent developments, present trends, and problems ahead are discussed. (L.N.N.)

2749 NUCLEAR POWER REACTORS. Nuclear Energy, 452-7; 473(Nov. 1961).

The development status of power reactors is discussed in regard to the problems and economic aspects of power in the future. Such topics as reactor types, power economy, reactor improvements, fuel development, and radioactivity are briefly discussed. (N.W.R.)

2750 THE DRAGON PROJECT: PROGRESS REPORT. Nuclear Eng., 6: 454-8(Nov. 1961).

Changes made in the Dragon Project are described. No fundamental changes are made to the design of the high temperature gas-cooled reactor, but certain important changes in detail design are made. The fuel element canning and decanning facility is relocated outside the pressure vessel (but within the inner containment) for easier maintenance. Other changes and modifications described are for the fuel element and to the spike upon which it sits, simplification of the pressure vessel and bottom dome, core components, heat exchangers, and fission product removal and helium purification systems. (N.W.R.)

2751 FRANCE. BROAD, SELF-CONTAINED PROGRAMME; INDEPENDENT APPROACH. Nuclear Eng., 6: 459-65(Nov. 1961).

Developments in the French reactor program are outlined. A list of the reactors in service or under construction is presented. The characteristics of the electrical power producing reactors (EL-4, EDF-1, EDF-2, EDF-3, and the Sena Project at Chooz) are given. (N.W.R.)

2752 FUEL ELEMENTS IN SWEDEN, 1961. Hilding J. Mogard and Bengt T. Nelson (AB Atomenergi, Stockholm). Nuclear Eng., 6: 469-71(Nov. 1961).

The design and fabrication of the Agesta (Swedish power reactor) fuel element are described. The fuel element consists of 19 rod bundles containing sintered uranium oxide pellets canned in Zircaloy tubing. (N.W.R.)

2753 THE CONTRIBUTION OF CALDER HALL AND CHAPELCROSS TO THE CIVIL PROGRAMME. D. R. R. Fair and T. N. Marsham. Nuclear Power, 6: No. 67: 65-74(Nov. 1961).

The reactors at Calder Hall and Chapelcross are used for a range of large-scale experiments relating directly to factors affecting the design, commissioning, and fuel element performance of the civil stations. Thus the experimental work carried out in these reactors is projected to the civil reactor problems wherever possible. The organization of this experimental work is discussed along with the problems involved. Other topics discussed are: commissioning measurements for civil reactors; reactor physics, stability, and control; fuel element testing and burst cartridge detection procedures; and irradiation effects on materials. (N.W.R.)

2754 SAFETY ASPECTS OF CALDER HALL REACTOR OPERATION. E. L. Desbruslais. Nuclear Power, 6: No. 67, 75-8(Nov. 1961).

The safety aspects of the Calder Hall reactors are discussed. Only four main incidents have occurred in five years; all originated in the turbine or electrical plant. These incidents were: transformer trip, turbine valve failure, turbo-alternator pilot exciter fault, and lightning effect on grid. Modifications to the plant protection arrangements have since been incorporated. Over-all operation has shown that the safety measures have proven effective and that the highest safety standards are compatible with maintaining high output. The discussion concerns safety conditions and the revisions that have been made. The importance of the reactor operator in ensuring safety is shown. (N.W.R.)

2755 SELECTING A FUEL CYCLE FOR MAGNOX REACTORS. [PART] 1. N. L. Franklin, A. Johnson, and E. Clough (United Kingdom Atomic Energy Authority, Risley, Eng.). Nuclear Power, 6: No. 67, 79-83(Nov. 1961).

The real problem of fuel cycle selection is one of lack of information on available reactivity, fuel endurance, and modes of failure. This discussion deals with the data which affect decisions on fuel cycles under the headings: fuel operating criterion, coolant and flux distribution, fuel element performance, charge/discharge machine capacity, and fuel cycle analysis (fuel logistics, reactivity and power, and detailed flux and temperature studies). (N.W.R.)

2756 APPLICATION OF ION EXCHANGE FOR CONTROL OF NUCLEAR ROCKET REACTORS. Chuk-Ching Ma (Rocketdyne, Canoga Park, Calif.). Nuclear Sci. and Eng., 11: 19-25(Sept. 1961).

Studies were made for the application of liquid poisons in lieu of moving control rods for shim control of core reactivity. Liquid control is achieved by: injection of neutron-absorbing poison into the system from a poison supply tank if lower core reactivity is desired; removal of a certain per cent of neutron-absorbing poison from the system by ion exchange if higher core reactivity is required; no poison is added to or subtracted from the system if no reactivity change is desired. Nitrate or other salts of cadmium, europium, or gadolinium are suggested for absorbing thermal neutrons, while silver, indium, or hafnium salts are used for the removal of resonance neutrons. A mixed solution containing one or more of these salts in any desired ratio can be prepared according to the need of a particular reactor. Boric acid can also be used. The principal advantages of using chemical poisons are lower capital cost, simpler maintenance, ready control of large reactivities, and elimination of rod hot-spot factors. The liquid control system under consideration was studied for its applicability to nuclear rocket reactor control, although it might also be feasible for the control of ordinary power reactors with certain modifications. (auth)

2757 OPEN LOOP STABILITY AND RESPONSE OF NUCLEAR ROCKET ENGINES. Harold P. Smith, Jr. (Univ. of California, Berkeley) and Alan H. Stenning. Nuclear Sci. and Eng., 11: 76-84(Sept. 1961).

The open loop dynamic performance of a nuclear rocket engine with bleed turbine or topping turbine drive is studied using an analog computer. The dynamics are accurately described by a system of ordinary, nonlinear differential equations. A linear approximation to these yield a stability criterion that is a function of (a) the rate of change of reactivity with temperature at constant propellant density, (b) the rate of change of reactivity with propellant density at constant core temperature, and (c) the relation between states of zero time rate of change of core inlet pressure. An explicit prediction of (c) is given and enables a simpler criterion to be established. The engine is stable if (a) is negative. The system is remarkably insensitive to changes of the major coefficients and can safely withstand large perturbations. It is shown that the long term response, which is dependent on the mechanical inertia of the turbopump, is of the order of ten seconds for vehicles in the million pound thrust class and that reduction of the thermal inertia of the core does not improve the response. The simulation results are explained on the basis of physical considerations and analysis in which the root locus technique proves useful. (auth)

2758 TRAWSFYNYDD POWER STATION. PART I. HEAT-EXCHANGER FABRICATION. Welding and Metal Fabrication, 29: 350-61(Sept. 1961).

Fabrication techniques used in the construction of the heat exchanger for the Trawsfynydd power station are described. Due to the size of the heat exchanger shell, it is necessary to carry out an appreciable amount of the work in a shop built on site. For technical and economic reasons, however, the greater part of the work is carried out in the shop and delivered in the largest possible components. The equipment used for transportation and fabrication is briefly described. The welding procedures and testing methods are also briefly described. (N.W.R.)

2759 TRAWSFYNYDD POWER STATION. PART 2. REACTOR VESSEL FABRICATION. Welding and Metal Fabrication, 29: 362-9(Sept. 1961).

Fabrication techniques used in the construction of the reactor pressure vessels for the Trawsfynydd power station are described. Welding techniques and erection methods are described in particular for the 61-ft ID sphere fabricated from 3½-in.-thick mild steel boiler plate. The sphere is mounted on a 25 ft 6 in. diameter steel skirt that extends upward through the base of the spherical shell by a special forged cruciform section. The cruciform forms an internal flanged skirt for supporting the fabricated grid structure, on which rests the graphite moderator core. Diagrams of the welding positions are given. The radiographic inspection tests for the vessel are also described. (N.W.R.)

2760 FAST REACTORS. R. G. Palmer and A. Platt. "Nuclear Engineering" Monographs. London, Temple Press Limited, 1961. 101p.

The physics, engineering, and metallurgical aspects of fast reactors are reviewed. Problems that must be solved for the design of an economic and safe fast reactor power plant are pointed out. Information is included on choice of materials, sodium technology, statics, dynamics, and heat transfer in liquid metals. (N.W.R.)

2761 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE, MARCH 21, 22, AND 23, 1961. VOLUME XXIII. Chicago, Illinois Institute of Technology, 1961. 985p. $10.00.

One hundred and two papers are included; separate abstracts have been prepared for eight. One paper was previously abstracted in NSA. Problems and information are given concerning matters of interest to the power industry and associated groups. (N.W.R.)

2762 NUCLEAR FUEL CELLS. R. E. Henderson (General Motors Corp., Indianapolis). p.44-8 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

The development and applications of nuclear fuel cells are discussed. The efficiency of the cell is theoretically explained by using the H_2-O_2 fuel as an example. The regenerative processes to be used in nuclear cells are given. (N.W.R.)

2763 ENGINEERING FRONTIERS OF THERMONUCLEAR POWER. C. W. Little, Jr. (C-Stellarator Associates, Princeton, N. J.). p.57-62 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology 1961.

The engineering developments in the field of thermonuclear power are discussed by examining the progress being made in the development of controlled thermonuclear reactions. The main interest of this study is to develop large amounts of inexpensive power. The accomplishments of the work on Princeton University's C-Stellarator are discussed in regard to progress being made in this field. (N.W.R.)

2764 GAS-COOLED REACTORS: PRESENT STATUS AND FUTURE PROMISE. Peter Fortescue, Titus G. LeClair, and Corwin L. Rickard (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.63-72 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

A description is given of the performance features and the development programs and problems of high-temperature, gas-cooled reactors. The results obtained show that reactors with high fuel-burnup hold great promise for the future. The HTGR system has the ability to use high steam pressure and temperatures and to attain an overall efficiency of 40 percent. (N.W.R.)

2765 THE TECHNICAL AND ECONOMIC STATUS OF CENTRAL STATION BOILING-WATER REACTORS. R. B. Richards (General Electric Co., San Jose, Calif.). p.73-80 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

A review is given of the progress made in boiling-water reactor technology and the work which must be done to achieve the goal of widespread economic nuclear power. Already technological progress permits design and construction of 400 Mw plants at $183 a kilowatt with a total generation cost of approximately 6.76 mills per kilowatt-hour at startup, decreasing to 6.46 mills per kilowatt-hour for the second core load. Development programs under study are the high power density, forced circulation systems; improved compaction and layout; improved fuels and materials; and nuclear superheat systems emphasizing improved heat rates. (N.W.R.)

2766 THE TECHNICAL AND ECONOMIC STATUS OF CENTRAL STATION CLOSED-CYCLE WATER REACTORS. J. W. Simpson (Westinghouse Electric Corp., Pittsburgh). p.81-6 of "Proceedings of the American Power Conference. Volume XXIII. Chicago, Illinois Institute of Technology, 1961.

Three successful generations of closed-cycle water reactors—the Nautilus prototype, Shippingport, and Yankee—are providing operating experience for the design and development of plants of increased size. Results from these reactors show that economic nuclear power in the higher fuel cost areas can and will be produced. Developments in the areas of reduction in component and system costs and increase in rating or utilization of equipment of any given size are of major interest at this time. These plants are even now at the stage where technological effort can be applied to give immediate results in cost reduction consistent with safety and reliability. (N.W.R.)

2767 AN INTEGRATED TURBINE-REACTOR CONTROL SYSTEM FOR THE SODIUM REACTOR EXPERIMENT. R. J. Hall (Atomics International, Canoga Park, Calif.) and F. C. Six. p.281-8 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

The electronic control system for the Sodium Reactor Experiment is described along with the operating performance and control execution of the system. The system maintains a constant steam pressure and temperature gradient across the reactor with rapidly changing electric power, sodium flow, and reactor power. (N.W.R.)

2768 THERMOELECTRIC GENERATING AND COOLING DEVICES. James D. Richards (Minnesota Mining and Mfg. Co., St. Paul). p.446-57 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

The development problems and future of thermoelectric generating and cooling devices are discussed. The operating principle, generator performance, material properties, heat transfer performance, economic status, and applications of thermoelectric devices are also discussed. The results show that the devices will become attractive when low-cost automated assembly techniques become a reality and as more efficient materials become available. (N.W.R.)

2769 OPERATING EXPERIENCE WITH HIGH FLOW RATE CONDENSATE POLISHING EQUIPMENT AT DRESDEN. A. B. Sisson (Commonwealth Edison Co., Chicago), R. C. Reid, and H. W. Frazer. p.600-10 of "Proceedings of the American Power Conference. Volume XXIII." Chicago, Illinois Institute of Technology, 1961.

Operating experience with high flow rate, externally regenerated demineralizers operating directly in the cycle has proved to be a satisfactory method of providing high quality reactor feedwater. The equipment and concept of the polishing system was thoroughly tested during initial station operation involving many startups, load changes, and shutdowns. Problems with external resin regeneration originated primarily in the waste treating plant rather than in the transfer and regeneration equipment itself. Pressure loss across the complete polishing system was less than 50 psi, except as a result of temporary abnormal flow conditions. The ion exchange resins were still in excellent condition and resin replacement will not be a significant factor in the cost of operation. (N.W.R.)

2770 IMPROVEMENTS IN OR RELATING TO STEAM TURBINES AND THE LIKE. George Gordon Jackson and Harold John Coles (to Mitchell Engineering Ltd.). British Patent 876,850. Sept. 6, 1961.

A power turbine-boiling water reactor arrangement is designed with the power turbine disposed within the reactor. In operation, the reactor is rotated by the turbine, and power may be abstracted, e.g., by a gear mechanism. The advantages of such an arrangement are: (1) The greater pressure at the outer periphery of the reactor, due to centrifugal forces, will cause the boiling to occur at the inner water surface, thereby preventing steam from diluting the water's moderating properties. (2) The steam, being subject to centrifugal forces, will be drier passing to the turbine. (D.L.C.)

Research Reactors

2771 (AAEC/E-59) FAST NEUTRON FLUX AND SPECTRUM MEASUREMENTS IN HIFAR. K. P. Nicholson and W. R. Quealy (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1961. 21p.

Results are presented of measurements of the fast neutron fluxes and energy spectra in the core and 2v experimental facilities of HIFAR using threshold detectors. The following reactions were used: $P^{31}(n,p)Si^{31}$, $S^{32}(n,p)P^{32}$, $Ni^{58}(n,p)Co^{58}$, $Al^{27}(n,\alpha)Na^{24}$. The total fission flux in the flux scanning tubes was found to be 23 ± 3% of the total effective flux at the same position, having a maximum value of 4.3×10^{13} neutrons/cm^2/sec (approximately 8.3 Mw thermal), for a maximum effective flux of 1.7×10^{14} neutrons/cm^2/sec. A neutron energy spectrum differing only slightly from a fission spectrum shape was found in all positions. The use of the $Ni^{58}(n,p)Co^{58}$ reaction as a fast flux monitor is discussed. (auth)

2772 (AAEC/E-59(Suppl.1)) FAST NEUTRON FLUX AND SPECTRUM MEASUREMENTS IN HIFAR. FIRST SUPPLEMENT—AVERAGE FISSION SPECTRUM CROSS SECTION FOR $Ni^{58}(n,p)Co^{58}$. J. W. Boldeman and K. P. Nicholson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Oct. 1961. 3p.

The $Ni^{58}(n,p)Co^{58}$ reaction cross section in a fission spectrum was re-measured and found to be 102 ± 3 millibarns. (auth)

2773 (HW-63678(Rev.)) REPORT ON HEAT TRANSFER EXPERIMENTS CONCERNING THE PRTR MARK I FUEL ELEMENTS. G. M. Hesson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1960. Contract AT(45-1)-1350. 44p.

Electrical resistance heating was used to simulate nuclear heating in a full scale model of a Mark I fuel element for the PRTR. The test section consisted of 19 rods, 0.564-inch OD, 7.3-feet long, and a 3.25-inch ID process tube. The most significant departures from reactor conditions were that light water coolant and a linear-longitudinal heat flux were used instead of heavy water coolant and a cosine-longitudinal heat flux. The test section, operating at tube powers of 750, 1250, 1500, and 1800 kw, was subjected to a series of successively decreasing flows until outlet steam qualities of 15 to 20 wt % were obtained. At each flow setting, pressure drop across the heated section was measured and temperatures of the water and the heated surface were noted at several points in a cross section near the downstream end of the section. In addition to these runs, one run was made at full flow with a tube power of 2000 kw. During the runs, the flow was not reduced to the boiling burn-out condition because of the risk of destroying the test section. The termination flows, heat fluxes, and steam qualities at the outlet are tabulated for the various tube powers. (auth)

2774 (IDO-16710) MATERIALS TESTING REACTOR—ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, APRIL 1—JUNE 30, 1961. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Contract AT(10-1)-205. 65p.

Dynamic and stability analysis is being conducted on a chemical control system in connection with the ATR. Design parameters will be determined for a prototype loop to be tested in the ETR. Six MTR shim rod calibrations made since the startup of the reactor were recalculated by an empirical formula and the results of all six compared. Measurements in the ARMF have tentatively determined the ratio of $\eta(Pu^{239}/\eta(U^{235})$ to equal 0.980 ± 0.009. Further calculations of cross section indices were made. These indices are now available for thermal absorbers including Pu^{240}, In, Mn, Au, Co, Th^{232}, and U^{238}. The indices for absorption and fission cross sections are available also for U^{233}, U^{235}, and Pu^{230}. In fuel element development studies, the continued irradiation of sample fuel plates containing U_3O_8 dispersed in an Al matrix showed a reaction of U_3O_8 with Al. The reaction was just as extensive as that of UO_2 with Al. Cross section measurements include preliminary determinations for Pa^{233} between 0.02 and 10 ev on unseparated samples. The initial irradiation does not provide a good value for a thermal cross section, but the results definitely indicate there are no large resonances near thermal energy. The results also provide information on the important resonances above 0.5 ev. It is anticipated that future irradiations will provide considerably more information on the cross section of this material. Work is in progress to measure the fission cross section of Pu^{241} in the energy range of 0.025 to 0.6 ev. Yield ratios of isomeric pairs $Ir^{192}-Ir^{192m}$ and $Rb^{86}-Rb^{86m}$ were determined as being 1.3 ± 0.2 and 0.13 ± 0.01, respectively. The formation cross section of Rb^{86m} was measured as 0.055 ± 0.003 barns. Installation of an auxiliary unit for the TMC 256-Channel Analyzer permitted the system's alternate operation as either a four 64-channel or a two 128-channel time-of-flight analyzer. The auxiliary or logic unit divided the 256 channels in such a manner as to require no internal modifications to the analyzer itself. Preliminary results indicated that a very low intensity 703-kev gamma ray is associated with the decay of 6.6-min Nb^{94m}. Five new gamma rays were observed in the gamma spectra of 22-hr Ho^{166}. Their coincidence relationships were determined and a level scheme for Er^{166} is presented which clears up some discrepancies between the level schemes derived from the decay of Ho^{166}, Ho^{166m}, and Tm^{166} to levels in this nuclide. A Monte Carlo program for neutron generation time was compiled in FORTRAN-II for a 32k, CDC-1604. It is checked out and ready for use. The reactor configuration considered is a multiregion cylinder of finite height. Certain inconsistencies arose in the manner in which interface conditions were used in the diffusion multigroup, multiregion equations to get numerical solution. This was corrected in the DMM program presently used. Several programs prepared for the IBM 650 include evaluating inhour equations for periods of from 1 msec to 10,000 sec at 20 points per decade. These programs solve reactor kinetic equations when reactivity is either a quadratic or a cosine function of time, thereby facilitating the processing of data taken in SPERT-II. (auth)

2775 (IEA-43) CHEMICAL PROBLEMS ARISING IN THE OPERATION OF A SWIMMING POOL REACTOR AND USES OF THE REACTOR IN CHEMISTRY. Fausto W. Lima (Sao Paulo, Brazil. Universidade. Instituto de Energia Atomica). Aug. 1961. 24p.

Presented at Symposium on the Programming and Utilization of Research Reactors, Vienna, October 1961.

Operations of the reactor are discussed in terms of: water treatment, maintenance, and analysis; fuel element corrosion; radiochemical determination of fission products in the pool water; and radioisotope production for medical applications and chemical research. Chemical problems solved by use of radioisotopes produced at IEA-R1 as labeling materials include; separation of zirconium from hafnium, isotopic dilution analysis of phosphorus in uranium compounds, control of purification procedures for uranium compounds, activation analysis of sodium in the pool water, activation analysis of hafnium in zirconium, activation analysis of sodium in graphite, and simultaneous activation analysis of gold and uranium in minerals. (B.O.G.)

2776 REACTIVITY EFFECTS ON THE AVOGADRO RSI REACTOR. G. Szabó Miszenti and M. Coli (SORIN, Saluggia, Italy). Energia nucleare (Milan), 8: 584-7(Sept. 1961). (In Italian)

Some results obtained during calibration work performed on the Avogadro RSI swimming pool type reactor are given. Reactivity effects were measured in control rod calibration and U^{235} gram worth, void coefficient, xenon poisoning effect, and temperature coefficient determinations. Thermal column, beam tubes, and other irradiation facilities reactivity effects are also reported. (auth)

2777 APPLICATION POSSIBILITIES OF NUCLEAR REACTOR VVR–S. Fráňa Musílek, Lubomír David, Vladimír Kačena, and Jirí Skřivánek (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 343-8(1961). (In Czech.)

Some physical data are given on the VVR-S with respect to irradiation engineering service, nuclear physics experimental work, radioisotope production, and reactor engineering. An evaluation is also given of operational experiences. (N.W.R.)

2778 THE NBS HIGH FLUX REACTOR DESIGN. Nuclear Power, 6: No. 67, 84(Nov. 1961).

The design for the National Bureau of Standards tank-type 10 Mw high flux research reactor is nearing completion. The reactor will be used by the Bureau at Gaithersburg, Maryland, to establish precision measurement techniques and to study basic properties of matter. The plan of the reactor is shown along with an elevation section. The reactor is heavy-water moderated and cooled, and fueled with enriched uranium similar to the CP-5 at Argonne. The core will have 24 fuel assemblies of uranium alloy fuel, clad in aluminum. (N.W.R.)

2779 THE CONTROL AND INSTRUMENTATION OF A NUCLEAR REACTOR. A. B. Gillespie (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs., (London), Pt. B, 103: 564-76(Sept. 1956).

A survey of research-reactor instrumentation is presented. Emphasis is placed on measurement and control problems. Presently used instruments are described, and their shortcomings are indicated. New developments are reviewed. Safety-circuit design is outlined, and examples of instruments and circuits used at Harwell are given. (L.N.N.)

2780 THE UNIVERSITY OF WASHINGTON NUCLEAR REACTOR. Harold E. Wessman and Albert L. Babb (Univ. of Washington, Seattle). Research Reactor J., 1: No. 4, 1-4(July 1961).

The nuclear characteristics, specifications, and experimental facilities of the University of Washington Training Reactor are discussed. The UWTR, which went critical on April 10, 1961, will be used primarily for graduate teaching and associated research. The reactor will normally be operated at a power level of 10 kilowatts. The immediate research uses for the reactor in addition to the regular teaching requirements include: pile oscillation studies using a BF_3 pile oscillator, studies of fast neutron attenuation in shielding materials, activation analysis, biological studies, reactor dynamics, and preparation of short-lived radioisotopes. The safety aspects of the reactor are also briefly discussed. (N.W.R.)

2781 ON PULSING THE ARGONAUT. R. D. MacLain (Univ. of California, Los Angeles). Research Reactor J., 1: No. 4, 5-9(July 1961).

The capability and problems involved in pulsing the Argonaut research reactors are discussed. Since the reactor has kinetic characteristics very similar to the BORAX and SPERT reactors, it seems reasonable that the Argonaut should have strong inherent pulsing capability. In order to predict pulsing response, a comparison is made of pulsing in BORAX I and the pulsing that should occur in the UCLA Argonaut (UCTR). (N.W.R.)

2782 THE UNIVERSITY NUCLEAR CENTER AT DELFT, THE NETHERLANDS. Hans Robert Kleijn (Delft Technological Univ., Netherlands). Research Reactor J., 1: No. 4, 10-14(July 1961).

The swimming pool reactor at Delft Technological University in the Netherlands is described. The research reactor will operate at a power level of 1 Mw with the initial operation period not to exceed 100 kw. The reactor will use light water as moderator, coolant, and partial shielding. The reactor will be housed in a gastight, dome-shaped steel structure. The safety aspects of the reactor are described. The reactor and laboratories will go into operation before the middle of 1962. (N.W.R.)

2783 A MODIFIED PILE OSCILLATOR FOR THERMAL NEUTRON CROSS SECTION MEASUREMENTS. J. N. Anno (Battelle Memorial Inst., Columbus, Ohio). Research Reactor J., 1: No. 4, 15-22(July 1961).

A modified pile oscillator designed and constructed at the Battelle Research Reactor is described. This device cycles a material whose cross section is being measured through an annular neutron-sensitive ion chamber imbedded in the thermal column of the reactor. The amplitude of the signal from the ion chamber generated by neutron absorption in the sample while passing through the chamber is indicative of the thermal neutron absorption cross section. Direct comparison of this amplitude with the amplitude of signal generated by a standard of known cross section determines the thermal neutron absorption cross section of the unknown sample. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

2784 (AD-255038) THERMODYNAMIC PROPERTIES OF THE HYDROGEN, HELIUM AND LITHIUM PLASMAS. Henry A. Mcgee, Jr. (Georgia Inst. of Tech., Atlanta and National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.) and Gerhard Heller (National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.). [1960]. 17p.

The results of calculations of the thermodynamic properties of H, He, and Li plasmas are given in tabular form. A partition function was developed for the most physically realistic model of the plasma that may be formulated. The internal partition function for all of the species of the hydrogen, helium, or lithium plasmas is formed by the series due to the electronic energy levels multiplied by the appropriate nuclear spin statistical weight. It was found that the electronic partition function would diverge except for the depression of the ionization energy due to the presence of ions in the plasma. The plasma was also considered as a Debye-Huckel ionic solution. (M.C.G.)

2785 (AD-256797) MAGNETOHYDRODYNAMIC VORTEX POWER GENERATION. W. S. Lewellen (Aerospace Corp., El Segundo, Calif.). Mar. 15, 1961. Contract AF04(647)594. 35p. (TDR-594(1203-01)TN-2)

The possibility of using a hydrodynamically driven vortex to convert thermal energy into electrical energy was investigated. Two promising areas of application as a space power generator were uncovered. The first is as a short-term power supply when used in conjunction with a rocket exhaust and the second is as a long-term power supply when used in a closed cycle nuclear system. Estimates of the operating characteristics of the MHD vortex in both of these environments are presented. It was concluded that the open cycle MHD vortex should be competitive with other systems for operating times between a few seconds and an hour at power levels above a few kilowatts. It was also concluded that replacing the turbo-alternator package in a closed cycle nuclear system with an MHD vortex provides a potential increase in the specific power output (KW/lb) of the order of 100% for power levels above a few hundred kilowatts. (auth)

2786 (JPL-TR-32-150) BEHAVIOR OF MATERIALS IN SPACE ENVIRONMENTS. L. D. Jaffe and J. B. Rittenhouse (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 1, 1961. Contract NASw-6. 123p.

The quantitative effects of the environments encountered in various regions of space upon several kinds of engineering materials are discussed. In the vacuum of space, magnesium sublimes appreciably at elevated service temperatures; zinc and cadmium sublime at ordinary temperatures. Most other engineering metals will be unaffected by vacuum except for a slight surface roughening. Among the organics, polysulfides, cellulosics, acrylics, polyvinyl chloride, neoprene, and some nylons, polyesters, epoxys, polyurethanes, and alkyds break down at rather low temperatures in vacuum. Polyethylene, polypropylene, most fluorocarbons, and silicone resins do not decompose significantly in vacuum below 250°C. Except for plasticized materials, significant loss of engineering properties in vacuum is unlikely without appreciable accompanying sublimation or decomposition. Also, escape of gases through walls which are gas-tight at 1 atmosphere will not be of concern. For parts intended to move in contact with each other in vacuum, lubrication is a serious problem. Certain low vapor pressure oils and greases, tetrafluoroethylene, and thin films of MoS_2, Au, and Ag can probably provide adequate lubrication when suitably selected for the speeds, loads, and times of service. The particles of the Earth's radiation belts will cause radiation damage to organics and to optical properties of inorganic insulators. Semiconductors will be damaged in the inner belt; their more sensitive properties will also be affected by solar flare emissions. Exposed surfaces of most materials may be damaged by the radiation belts and perhaps by solar charged particle emissions. Optical properties of exposed polymers and ceramics will also be affected by solar ultraviolet and x rays. Sputtering away of material by collision with ions or atoms in space is probably negligible. Erosion by meteoroids is significant only close to the Earth. The probability of penetration by meteoroids falls sharply with increasing distance from Earth. Much more frequent than penetration is spalling of fragments from the inside of walls struck by meteoroids. The efficiency of walls in preventing penetration and spalling can be increased by splitting the walls into a thin front plate and a thicker main plate; quantitative bases for the design of such spaced armor are presented. (auth)

2787 (JPL-TR-32-166) CONTROL AND GUIDANCE OF ELECTRICALLY PROPELLED SPACECRAFT. Phillip J. Hirrel (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Sept. 15, 1961. Contract NASw-6. 25p.

Control and guidance for nuclear-electric spacecraft are discussed. The broad aspects of the flight trajectory peculiar to ion propulsion are examined and equipment limitations are reviewed. (J.R.D.)

2788 (NP-10930) EXPERIMENTAL EFFECTS OF SCALING ON THE PERFORMANCE OF ION ROCKETS EMPLOYING ELECTRON-BOMBARDMENT ION SOURCES. Paul D. Reader (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). [1961]. 20p.

Presented at the National IAS-ARS Joint Meeting, Los Angeles, California, June 13-16, 1961.

Previous investigations have shown that the electron-bombardment ion rocket holds considerable promise as a mechanically simple, reliable, and efficient space propulsion device. A scaling program was undertaken to establish the relations between performance parameters and the size of the electron-bombardment ion source. Three ion sources were fabricated and tested. The first of these, a 10-cm-diameter source, has achieved power efficiencies over 80% at a specific impulse of 8300 sec. It has been operated continuously for 10 hr at thrust levels above 10 millipounds. Beam currents of 1/2 amp have been attained yielding thrust values of up to 20 millipounds at 8300 sec. Two geometrically similar sources of 5 and 20 cm in diameter were scaled from the 10-cm-diameter source to allow a performance comparison to be made. The same grid spacing was used for all accelerator systems so that constant current per unit area would be expected. The three ion sources are compared for ion chamber characteristics and over-all power efficiency. The effects of size on operating limits are discussed. Mercury was used as the propellant. (auth)

2789 (NP-10934) PROPERTIES OF EQUILIBRIUM DISSOCIATING HYDROGEN FOR PREDICTING CONVECTIVE HEATING IN NUCLEAR-THERMAL ROCKETS. Daniel E. Rosner (AeroChem Research Labs., Inc., Princeton, N. J.). Feb. 1961. Contract Nonr-2773(00). 49p.

Estimates are given of the Lewis-Semenov number and the chemical contributions to the heat capacity, enthalpy, thermal conductivity, heat flux potential, and Prandtl number for equilibrium dissociating hydrogen at 1000 to 4000°K and at total pressures of 0.1 to 100 atmospheres. In applying these data to the nuclear-thermal rocket nozzle cooling problem, a new convection-product parameter is introduced and evaluated. It is proposed that equality of this convection-product parameter implies the approximate equality of the convective heat flux intensity regardless of physical scale, pressure level or choice of working fluid. If the nozzle cooling requirement limits the potential performance of a nuclear-thermal rocket, it is concluded that specific impulse gains can be made only by reducing the chamber pressure level. (auth)

2790 (NP-10947) EQUIPMENT DESIGN CONSIDERATIONS FOR SPACE ENVIRONMENT. S. N. Lehr, V. J. Tronolone, and P. V. Horton (Space Technology Labs., Inc., Los Angeles). Sept. 1960. 73p. (STL/TR-60-0000-09224).

Information is presented on some types of materials and electronic parts used successfully in those space vehicles which have accomplished their objectives. The effects of short wave electromagnetic radiation, micrometeorites, high vacuum, temperature control, and radiation are discussed. Materials and parts are listed. (M.C.G.)

2791 (NP-10980) SULFUR HEXAFLUORIDE AS A FUEL FOR IONIC PROPULSION. Final Report. Gillis G. Cloutier and W. A. Evans (RCA Victor Co., Ltd. Research Labs., Montreal). June 1961. Contract AF33(616)-7437. 64p.

Experiments are described on the generation of an intense beam of SF_6^- negative ions by an electron bombardment method. Some theoretical considerations are given on the basic processes for the generation of negative ions, the characteristics of an electron bombardment ion source and the relevant properties of the sulfur hexafluoride molecule. A detailed description of the experimental system is presented and the important features in the design of the ion source are discussed. In particular, the feasibility of introducing the gas in the ion source in the form of a well defined stream is demonstrated thus ensuring a high ion conversion efficiency for this ion source. Time-of-flight-mass spectrometer measurements indicated that only SF_5^- and SF_6^- ions were produced in that source and that the SF_5^- contribution to the total ion current was negligible. The negative ion current as function of the electron bombarding energy exhibits a complex resonance spectrum. The limitation to the maximum negative ion current produced by this method is set by space charge effects in the bombarding electron beam. It is found that the negative ion current is still increasing as the maximum handling capacity of the gas collimator is reached. It is concluded that if space charge limitations can be eliminated a negative ion current adequate for electrical propulsion could be generated with sulfur hexafluoride. (auth)

2792 (P-1335(RAND)) SPACE VEHICLE ENVIRONMENT. C. Gazley, Jr., W. W. Kellogg, and E. H. Vestine (RAND Corp., Santa Monica, Calif.). July 7, 1958. Revised June 15, 1959. 60p.

Presented at the National Summer Meeting of the Institute of Aeronautical Sciences, Los Angeles, July 8-11, 1958.

Various physical space attributes of the natural environment in the solar system are estimated and discussed. A survey was made of the characteristics of solar radiations, the effects of solar and other thermal radiations on vehicle temperature, the characteristics of the earth's magnetic fields and other magnetic fields in space, the earth's exosphere and the solar corona, cosmic rays, and meteoroids. Estimates of the probability of vehicle skin penetration by meteoroids are also presented. (auth)

2793 NUCLEAR ENERGY IN SPACE—RADIOISOTOPE AUXILIARY POWER SYSTEMS. Jerome G. Morse and Douglas G. Harvey (Martin Co., Baltimore). Aero/Space Eng., 20: No. 11, 8-9; 58-62(Nov. 1961).

The radioisotope auxiliary power systems to be used in space are discussed. Included in this discussion are typical radioisotopic heat sources and the specifications for several of the SNAP generator systems. The re-entry into the earth's system, cost, safety, and future of the systems are also discussed. (N.W.R.)

2794 MISSILE AND SPACE ELECTRONICS. MISSILE AND SPACE PLANS, GUIDANCE AND CONTROL, DATA ACQUISITION AND TRANSMISSION, PROPULSION AND POWER GENERATION, EARTH-BASED ELECTRONICS. John F. Mason and Michael F. Wolff. Electronics, 34: No. 46, 87-118(Nov. 17, 1961).

United States missile projects, goals, and budget aspects are discussed. Missile guidance and control systems are described, and data acquisition methods and equipment are explained. Propulsion and power generation, especially that derived from nuclear and electrical devices, are discussed. Finally, earth-based electronic devices which are important in missile operations are described. (L.N.N.)

WASTE DISPOSAL AND PROCESSING

2795 (AAEC/E-74) THE EFFECT OF SURFACE ACTIVE AGENTS ON DECONTAMINATION OF RADIOACTIVE AQUEOUS WASTES BY PRECIPITATION AND COAGULATION PROCESSES. C. R. Frost (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1961. 11p.

The effect of the presence of certain surface active agents on decontamination using the calcium/ferric phosphate process in a sludge blanket clarifier was investigated. Little trouble with such agents should be experienced in the treatment of effluent at Lucas Heights. (auth)

2796 (AAEC/E-75) TWO PROCESSES FOR DECONTAMINATION OF RADIOACTIVE AQUEOUS WASTES BY PRECIPITATION AND COAGULATION. C. R. Frost (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1961. 19p.

In an investigation of the efficiency of the calcium/ferric phosphate process for removal of various radioisotopes from solution using a sludge blanket clarifier, 70% removal of uranyl and strontium ions and mixed fission products was achieved but cesium removal was poor. Dosing ion concentrations were 80 ppm PO_4^{3-}, 50 ppm Ca^{2+}, and 40 ppm Fe^{3+}, used at an initial pH of 11.5. Use of a lower concentration and lower pH values did not materially affect removals. In batch experiments to find the optimum concentration of ions for precipitation at a pH of 9.5 it was found that concentrations of 90 ppm PO_4^{3+}, 50 ppm Ca^{2+}, and 40 ppm Fe^{3+} leave very small residual concentrations in the supernate. Removals of radioisotopes from solution by precipitation using the aluminum hydroxide process are comparable with those in the calcium/ferric phosphate process, except for that of strontium. It is recommended that 8.0 be used as the maximum pH for the precipitation of aluminum hydroxide in the sludge blanket clarifier. Thickening experiments with a sludge blanket clarifier using both processes show that the degree of thickening is governed by the size and relative proportions of the clarifier. (auth)

2797 (BM-RI-5874) DISPOSAL OF LIQUID WASTE IN THE DURANGO-TYPE URANIUM MILLING FLOWSHEET. K. E. Tame, E. G. Valdez, and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). Jan. 1961. 15p.

Possible modifications were studied in conventional uraniuum ore-processing steps to confine and permit controlled disposal of radioactive wastes. Surveys of Ra^{226} contamination of liquid wastes from uranium mills indicated that the Vanadium Corporation of America plant at Durango, Colo., had one of the more urgent problems. A possible procedure for minimizing the waste disposal problem was to reuse the waste solution in the mill—in effect, erasing the need for disposal of liquid waste. In examining this possibility, interlocked bench-scale leaching and solvent extraction tests simulating the Durango flowsheet were made. The simulated reuse of barren raffinate for leaching and washing was carried through three separate campaigns of 9, 12, and 35 cycles each. An attempt to expedite the test work by using agitation leaching during the first campaign resulted in pregnant solutions of varying turbidity, giving a discordant pattern of radioactivity analyses. Percolation leaching and washing patterned more nearly after the Durango flowsheet was used in the second and third campaigns and consistently gave solutions of satisfactory clarity. The radioactivity was somewhat variable but did not build up with prolonged recycling of the raffinate. The buildup of other impurities in the pregnant solution had little noticeable effect on the operation of the percolation leach column. Operational difficulties from slow phase disengagement and entrainment in the solvent extraction stripping and scrubbing units occurred during the first two campaigns. In the third campaign slow phase disengagement and aqueous entrainment in the strippers were practically eliminated by heating the last stage to about 40°C and operating with the aqueous phase continuous. Increased mixing time in the scrubbing section was successful in reducing entrainment of aqueous in the organic from the settlers. Also, the concentrations of active reagents in the solvent extraction system were increased during the third campaign to correspond to an increase made at the Durango plant. The recovery of uranium and vanadium from the acid leach solution was excellent, averaging 99.7 and 95.6%, respectively. During the test work the Durango plant made several changes in tailing disposal procedures to minimize the waste problem. The most important comprised impounding all barren raffinate in two large lagoons. This was a successful temporary solution to the problem. However, as evaporation is relied upon to eliminate the water, it is estimated that 40 acres of area will be needed. The use of barren raffinate for washing in the Durango process would greatly diminish the quantity of solution to be disposed of by solar evaporation and the conjunctive need for a large disposal area. (auth)

2798 (HW-59919) LIMITATIONS FOR EXISTING STORAGE TANKS FOR RADIOACTIVE WASTES FROM SEPARATIONS PLANTS. E. Doud and H. W. Stivers (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 22, 1959. Contract W-31-109-Eng-52. 21p.

The physical limitations of existing storage tanks for radioactive wastes from separations plants are defined as a guide for preparing process and operating criteria for the existing tank forms to assure continued integrity of the tanks. A "safe-load" curve for each of the four groups of tanks based on current technology is presented. Loading conditions, operation procedures, and thermal stresses are discussed. (M.C.G.)

2799 (HW-70517) QUARTERLY PROGRESS REPORT [ON] RESEARCH AND DEVELOPMENT ACTIVITIES FIXATION OF RADIOACTIVE RESIDUES, APRIL-JUNE 1961. E. R. Irish, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 15, 1961. Contract AT(45-1)-1350. 40p.

Research and development activities in the field of fixation of radioactive wastes are described. Batch calcination, melting of pot calcination products, spray concentrator test, spray calcination, temperatures in solidified wastes, off-gass treatment, fixation by mineral reactions, elution experiments, fixation chemistry, and condensate wastes are discussed. (M.C.G.)

2800 (ORNL-3189(p.1-6)) LOW-LEVEL WASTE WATER TREATMENT. K. E. Cowser, T. Tamura, et al. (Oak Ridge National Lab., Tenn.).

The process waste treatment plant at ORNL employs $CaCO_3$ precipitation for removal of Sr^{90} and addition of clay for removal of Cs^{137}. Laboratory studies and plant tests include classification of solids in the plant effluent, use of phosphates as a supplement to normal lime-soda softening, and use of natural minerals for second-stage treatment. Their pupose is to investigate methods of increasing fission-product removals by use of the plant facilities that are available. (auth)

2801 (ORNL-3189(p.27-42)) FUNDAMENTAL STUDIES OF SORPTION BY MINERALS. T. Tamura, F. S. Brinkley, et al. (Oak Ridge National Lab., Tenn.).

Removal of fixed cesium was significant only when cations capable of expanding the collapsed lattice were used. Intensive cropping by oats grown on vermiculite with fixed cesium released only about 1% of the sorbed cesium. In reactions involving strontium removal, the ion-exchange capacity, saturating cation, and surface characteristics of sorbent influenced the degree of sorption. Precipitation reactions involving calcium and phosphate ions were also important in removing strontium. Ruthenium removals were increased when reducing conditions were imposed on the system; chalcopyrite ($CuFeS_2$) was found to be one of the more effective minerals for sorbing ruthenium. (auth)

2802 (ORNL-3189(p.42-9)) SOIL COLUMN STUDIES. D. G. Jacobs and O. M. Sealand (Oak Ridge National Lab., Tenn.).

Particle diffusion coefficients were estimated for the migration of cesium to the interior of vermiculite platelets, and the effects of particle diffusion on column operation are discussed. Improvement of vermiculite column operation, based on an understanding of the reaction mechanism, was demonstrated. (auth)

2803 (ORNL-3189(p.69-72)) DISPOSAL IN DEEP WELLS. W. de Laguna and D. G. Jacobs (Oak Ridge National Lab., Tenn.).

In a full-scale experiment, two separate batches of grout, totaling over 200,000 gal, were injected into the local shale formation at depths of roughly 700 and 1000 ft. Test drilling, not yet completed, showed that the grout formed generally horizontal fractures extending out 400 to 500 ft from the injection well. Work was started on a test well, 3000 ft deep, to explore potential disposal formations not exposed at the surface; and a preliminary design and cost estimate of a disposal plant and well system to dispose of the Laboratory's medium-level waste stream was prepared. (auth)

2804 (ORNL-3189(p.72-7)) EVALUATION OF ENGINEERING, ECONOMICS, AND HAZARDS. R. L. Bradshaw and W. B. Nix (Oak Ridge National Lab., Tenn.).

A more thorough examination was made of tank storage hazards. The consequences of tank-cooling system failure were studied in detail. A study was undertaken, in cooperation with the ORNL Chemical Technology Division, to evaluate, first from economics and later from hazards standpoints, the various methods of high-activity liquid and solid waste disposal being investigated by the Laboratory. As a necessary part of this study, the various operations leading to these ultimate disposal methods will also be evaluated. The economics studies of interim liquid storage and conversion to solids by pot calcination were completed. (auth)

2805 (ORNL-3189(p.77-80)) RELATED COOPERATIVE PROJECTS. (Oak Ridge National Lab., Tenn.).

A number of investigations were made by and in cooperation with other groups, both governmental and private. Five engineers and scientists from other countries worked for varying lengths of time as members of the Radioactive Waste Disposal Section. (auth)

2806 (ORNL-3189(p.105-28)) FOREST ECOLOGY. J. S. Olson, D. A. Crossley, Jr., et al. (Oak Ridge National Lab., Tenn.).

Complex ecological systems like forests are maintained by a natural flux of energy and a circulation of chemical elements. Botanical, forestry, soils, zoological, microbiological, geochemical, and mathematical studies contribute to an understanding of these systems and the implications of their processes for the dispersal of environmental radioactivity. In addition to small acreages already contaminated by waste disposal, the Oak Ridge Reservation includes over 25,000 acres of land, in many stages of forest development, which is suitable for research. Residual, colluvial, and alluvial soils are derived from Paleozoic sandstones, shales, dolomites, and limestones. Permanent forest plots, sampling of forest biomass and productivity, and chemical analysis of plant and soil materials aid in planning for use of this Reservation and also provide information and samples that are needed for interpretation of tracer experiments. Biogeochemical studies include activation analyses showing environmental levels of stable cesium (2 to 9 μg per gram of soil and 0.02 to 0.12 μg/g in pine needles and boles), and cerium (40 to 400 μg per gram of soil and usually <0.25 μg/g in pine boles). Tracer experiments continue to follow the rapid ecological cycle of Cs^{134} in and near 12 white oak trees. Sampling indicates more rapid movement of cesium into and out of natural soils than might be expected from the high capacity of their illite or vermiculite clays to fix cesium. Other experiments with tagged leaves indicate leaching rates for Cs^{134} several times as rapid as decay rates of organic litter. Releases of Ru^{106}, Co^{60}, and Sr^{85} or Sr^{90} occurred at rates comparable with rates of litter breakdown for various leaf species. Arthropods and microorganisms hasten the breakdown of litter and the important natural cycle of nutrients and of isotopes. Changes in populations, respiratory activity, and litter weight loss are partly accounted for by the annual cycle of temperature, week-to-week or day-to-day fluctuations in moisture, and diurnal cycles of temperature. Mite and insect species also show striking differences related to stage in litter breakdown and to forest association (white oak vs pine). Fungi and bacterial counts varied over several orders of magnitude between leaf species (mulberry, redbud, oak, pine). Various microorganisms showed concentration factors of 2 to 48 for Co^{60} and smaller values for Cs^{134} in aqueous shaking cultures; in soil, however, concentration factors were higher for Cs^{134} than for Co^{60}. High uptake, rapid turnover, and frequent prompt release by microbial death from dessication or freezing suggest a greater role of microorganisms in isotope cycling than is indicated by their small biomass. Formulation of theoretical models for ecosystems was aided by simulating such a system on a large analog computer. One console was devised to simulate the transfer of biomass, while a second console was connected to record changes in radioactivity of plants, animals, and litter and soil materials. Selection of positive and negative feedback parameters offers possibilities for simulating diverse ecosystems when enough data on the pool sizes and turnover rates of their compartments can be synthesized. (auth)

2807 (ORNL-3189(p.129-39)) CLINCH RIVER STUDIES. D. J. Nelson, R. L. Herman, et al. (Oak Ridge National Lab., Tenn.).

Bottom organisms are being used to determine both the fate and radiation effects of radionuclides released to the Clinch River. A model using parameters obtained from laboratory experimentation and field observation showed that the feeding activities of tubificid worms did not contribute significantly to the downstream movement of radioactive river bottom sediments. The bottom-dwelling organisms in the Clinch River received an average dose which is 20 times that from naturally occurring radiation and in White Oak Creek the dose is about 1000 times background. Chironomus tentans Fabr. (midge) is a dipteran species with larval stages living in bottom muds. The use of sensitive cytogenetic techniques and analysis of the salivary gland chromosomes of this species showed a high frequency of chromosomal aberrations, including a number of individuals with three chromosomes instead of the usual four. About 40% of the Co^{60} taken up by crayfish was by adsorption on the exoskeleton and the uptake was directly proportional to the concentration in the environment. The rate of Co^{60} uptake was more rapid for hard-shelled individuals and large individuals. The excretion of Co^{60} was more rapid for small specimens and for those which were tagged by injection rather than in a radioactive solution. In the latter instance there was little or no Co^{60} associated with the exoskeleton from which loss of Co^{60} was slow. Radioassay of crayfish showed that the highest concentration of Co^{60} g^{-1} was in the exoskeleton. The hepatopancreas contained 86%, gut 49%, muscle, gonad, and blood each 0.14% as much Co^{60} as did the exoskeleton. A study of the strontium and calcium in the shells of Tennessee River clams showed that the calcium content was constant and constituted 40% of the shell. The strontium content was proportional to the growth rate of the clam's shell and varied from 150 to 500 ppm. The laboratory releases of Sr^{90} were considered as a tracer and the Sr^{90}-stable strontium atom ratios in clam shells downstream from White Oak Creek could be explained solely on the basis of the dilution of Sr^{90}-contaminated Clinch River water by noncontaminated Tennessee River water. This showed that Sr^{90} released to a surface water stream moves downstream in solution and there is little or no ionic exchange between the strontium in solution and that in the bottom sediments. Tagging fish with numbered tags showed that the white crappie tends to remain in the vicinity of initial capture. This species was selected for a study of fission-product element metabolism. During five months of tagging in 1960 and 1961, 5245 fish were tagged, and there were 150 returns by fishermen and our own netting operations. The fishermen returns showed a movement by white bass from the Clinch River downstream into the Tennessee River portion of Watts Bar Reservoir. (auth)

2808 (ORNL-TM-15) WASTE TREATMENT AND DISPOSAL PROGRESS REPORT FOR JUNE AND JULY 1961. R. E. Blanco and E. G. Struxness (Oak Ridge National Lab., Tenn.). Oct. 24, 1961. Contract W-7405-Eng-26. 57p.

High-Level Waste Calcination. Synthetic TBP-25 aluminum nitrate waste was calcined in the close-coupled continuous evaporator-pot calciner unit. Waste oxides from TBP-25 waste were incorporated into glassy materials after the addition of phosphate and borate fluxing agents. Melts formed at 850 to 950°C were glassy solids when cooled and had densities from 2.41 to 2.47 g/ml. Waste volume reduction factors were from 7.6 to 9.3. Low-Level Waste Treatment. A demonstration run was completed in the 60 liters/hr scavenging-ion exchange pilot plant on ORNL low-activity waste. Decontamination factors were satisfactory after 1500 resin bed volumes of waste had been treated, i. e, Sr > 1000, TRE 100, Cs > 100, and sufficiently high for other activities that the waste activity was reduced to <10% of MPC. The physical properties of vermiculite, clinoptilolite, and rock phosphate were found to be suitable for second-stage treatment of process waste. Engineering, Economic, and Hazards Evaluation. A cost study of the conversion of high-level solutions to solids by pot calcination was completed. Aging had a negligible effect on costs for processing in a given vessel size. The lowest cost was 0.87×10^{-2} mill/kwh$_e$ for processing acidic Purex and Thorex wastes in 24-in.-dia. vessels, and the highest was 5.0×10^{-2} mill/kwh$_e$ for processing reacidified Purex and Thorex wastes in 6-in.-dia. vessels. Disposal in Deep Wells. Test drilling at the site of the second fracturing experiment is nearly completed. The upper grout sheet extends out from the injection well some 500 ft to the east and northeast, but only short distances out in other directions. The lower grout sheet extends largely to the north and northwest, but its outer limits are still undefined. Disposal in Natural Salt Formations. Stress measurements in the pillars of the Hutchinson mine have shown the absence of horizontal stresses and the presence of vertical stress varying from 1300 to 1600 psi. Comparison of the data from the field cavities and theoretical calculations of temperature rises around spheres indicates that the thermal conductivity of the salt surrounding the experimental cavities is 2.6 Btu hr^{-1} ft^{-1} ^{0}F^{-1} and the diffusivity is 0.099 ft^2/hr. A computer code was designed for the solution of temperature rise in a heat-generating layer of infinite horizontal dimensions and in the salt surrounding the layer, as a function of time for wastes of variable age. The use of this code showed that the storage of waste decayed less than one year is wasteful of mine space and that the thickness of the slab from 1 to 10 ft has little effect on the temperature rise in the slab. Studies on radiolytic gas production of wastes in salt showed that gas production can be eliminated by pressurizing the cavity or by maintaining an atmosphere of hydrogen over the waste. Clinch River Studies. A continuous water-sampling system was installed at Centers Ferry on the Clinch River. The instruments were so designed that the rate of sampling is proportional to the velocity of flow in the river. Results of sorption tests on membrane filters indicate that essentially no strontium, cobalt, or ruthenium is sorbed as river water samples are filtered. A small percentage of cesium, 4%, is sorbed by the filters. Various types of bottom sediment core samplers were tested and evaluated for compaction and retention characteristics. Results of a recent silt range survey showed that additional cross section sampling sections, intermediate to the standard silt ranges, do not significantly change estimates of sediment volume. Fundamental Studies of Minerals. Sodium-vermiculite showed three distinct sorption-of-strontium responses in the pH range 2 to 11. Up to pH 4.5 the response depends on the displacement of aluminum from octahedral layers of the mineral. Thus, sorption was <10% at pH 2 and only 59% at pH 4.0; in both cases sorption was maximum after contact for less than 96 hr. Sorption increased uniformly (to ~70%) between pH 4.5 and 9.0 up to 96 hr contact. At pH 11 sorption sharply increases to 91% after 96 hr. Comparison of strontium removal by sodium-vermiculite, clinoptilolite, Duolite C-3, and Dowex 50 showed that sodium-vermiculite is ineffective at low pH but competitive at basic pH's. Particle diffusion processes have a pronounced influence on cesium breakthrough curves from small columns operated for rather short times. Extrapolation from bench-scale experiments to the field may require correction for this phenomenon, as the cesium loading increases with increased time of column operation. For prolonged column operation times, the effects of particle diffusion are not so pronounced. White Oak Creek Basin Study. An investigation was started to determine the vertical and lateral distribution of radionuclides in the bed of former White Oak Lake. Preliminary results from core samples taken along transects at the lower and upper ends of the lake indicate more gamma activity per gram at the upper transect than at the lower one, most of the gamma activity contained in the first 12 in. of soil, and activity in the upper few inches of each core rather uniformly distributed. (auth)

2809 (ORNL-TM-49) WASTE TREATMENT AND DISPOSAL PROGRESS REPORT FOR AUGUST AND SEPTEMBER 1961. R. E. Blanco and E. G. Struxness (Oak Ridge National Lab., Tenn.). Nov. 29, 1961. Contract [W-7405-Eng-26]. 57p.

Work is being carried out to develop and demonstrate on pilot plant scale integrated processes for treatment and disposal of radioactive wastes. High-level waste calcination, low-level waste treatment, economic and hazards evaluation, engineering evaluation, disposal in deep wells, disposal in natural salt formations, Clinch River studies, fundamental studies of minerals, and White Oak Creek basin study are discussed. (M.C.G.)

2810 (ORNL-TM-59) OPTIMUM FILL VOLUMES IN POT CALCINATION OF RADIOACTIVE WASTES. J. J. Perona (Oak Ridge National Lab., Tenn.). Nov. 17, 1961. Contract [W-7405-eng-26]. 5p.

The 15,000 MW nuclear economy assumed for the long range study of pot calcination costs reported earlier was used as a basis for calculating optimum fill volumes. An algebraic expression was developed for cost as a function of the normalized radius of the central void space in a partially filled vessel. Minima of this expression were found for acidic and neutralized wastes in 6, 12, and 24-in.-diameter vessels. Optimum fill volumes decreased as vessel diameter increased, varying for acidic wastes from 99.8% for 6-in.-diameter vessels to 92.5% for 24-in.-diameter vessels. Decreases in costs by using optimum fill volumes instead of the 90% fill volume assumed for all cases in the long range study were small, the largest being an 8% decrease for neutralized wastes in 6-in.-diameter vessels. (auth)

2811 PROCESS FOR PRECIPITATION OF RADIOACTIVELY CONTAMINATED WASTE WATER BY DIFFERENT RADIOCHEMICAL COMPOUNDS. Stefan Krawczynski and Basilios Kanellakopulos. Gas- u. Wasserfach, 102: 601-3(1961). (KFK-60). (In German)

A simple continuous process for the deactivation of radioactive contaminated waste water of different radiochemical composition is described. That the expense of the apparatus is very low and that the installation works automatically with a minimum of attention suits the process especially for the deactivation of waste water from small businesses and laboratories. The advantages of discontinuous installation lies in the possibility that the chemical precipitation can be adjusted to suit the waste water composition. In order to make the most of this possibility, a large technical as well as scientific staff must be present who are able to perform the difficult and expensive preliminary investigations of the waste water. For small businesses and laboratories therefore, this development makes possible the erection of a cheaper and more functional maintenance-free installation. (tr-auth)

2812 PROBLEMS OF RADIOACTIVE WASTES DISPOSAL IN THE NUCLEAR RESEARCH INSTITUTE. Vladimír Veselý (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). Jaderná energie, 7: 356-60(1961). (In Czech.)

A summary is given of work done in the Nuclear Research Institute in solving radioactive waste disposal problems. A small deactivation station for radioactive effluents is described, which consists of two systems: a boiler evaporator with an output of 200 kg evaporated water/hour and a film evaporator for 130 kg/hr. A description is also given of a large chemical precipitation station in which solid wastes will be pressed. A survey is given of work on natural absorbents and waste fixation. (N.W.R.)

2813 TREATMENT OF RADIOACTIVE WASTE. Kiyoli Kawamoto. British Patent 881,754. Nov. 8, 1961.

A method for reducing the gamma radiation from radioactive wastes is outlined which uses a gamma-absorbing element, gallium. The method comprises mixing the wastes with gallium or a gallium alloy, and then with water, and storing the mixture in a tub formed from concrete mixed with vermiculites containing gallium. (D.L.C.)

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